The Army's Facility Construction and Maintenance Process

An Assessment

AR009R1

December 2000

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Executive Summary

The Army and the private sector follow similar steps in their facility construction and maintenance processes. However, they differ in how they carry out these processes, especially in budget allocation and management practices. These differences result in higher costs for the Army in the design and construction phases of its process, as well as higher costs *and* lower efficiency in its maintenance phase.

The cost differences are striking. The Army spends 6 percent more of its program funding on its designs than does the private sector. Per square foot, Army construction costs are 9 percent higher for family housing and 24 percent higher for barracks and administrative buildings. Life-cycle maintenance cost differentials are even higher—the Army spends 27 percent more on its family housing and 31 percent more on its other facilities than the private sector.

The Army's operating environment is the primary cause of these differences. As a public-sector entity, it does not encounter the competitive market forces that shape efficient organizational behavior and mandate sound financial and organizational management. Consequently, Army budget allocation decisions and management practices promote a situation in which the Army builds more facilities than it can afford to maintain.

To address these root problems and reduce the Army's overall cost, we recommend the following:

- Amend the requirements development process:
  - ➤ Increase the use of planning charrettes to fully develop program requirements for selected projects.
  - ➤ Incorporate parametric design cost estimates in the DD Form 1391 submission; use that cost estimate as the basis for the military construction budget estimate.
- Consider the full program cost of a military construction project during program objective memorandum development: integrate the operations

and maintenance cost estimate with the military construction cost projection in proposed management decision package changes.

- Emphasize basic building designs with shorter "intended-use" design lives.
- Create web portals that permit installations to connect directly with U.S. Army Corps of Engineers "expert assistance centers" to facilitate mechanical and electrical design reviews.
- Establish a range of standard features for family housing designs; direct designers to select only from that range for design and construction.
- Aggressively implement guidance for using the design-build approach.
- Establish a user fee (a rent-like space charge) for units and activities. The fee should cover the costs of operating and maintaining occupied facility space, including the costs of projected capital renewal projects.
- Establish a working capital fund to finance real estate operations and maintenance activities (the primary source would be user fees).
- Institute effective property management practices at the installation level:
  - Develop program and budgets on the basis of installation needs and projected funding levels.
  - Establish facility management performance objectives.
  - Implement maintenance strategies—preventive maintenance, work force training, and contractor support—that not only help meet performance objectives, but also promote long-term efficiencies.
  - Employ management control techniques and information systems that ensure attainment of performance objectives.
  - Develop performance work statements for A-76 studies that focus on performance outputs, not on achieving specific labor qualifications.
  - Attract nonfederal tenants to lease underused space under the enhanced use leasing authority of 10 U.S.C. 2667; use the proceeds (or in-kind consideration) to help offset maintenance and repair costs.

Following these recommendations will require a modest investment to establish the working capital fund and to upgrade the Army computerized maintenance management system. The benefits are significant—a cost savings of over $500 million annually within 7 years of implementation, savings that, for one thing, could be used to reduce backlogs within the real property management accounts.

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Acknowledgment

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Chapter 1
Introduction

The Army is in transition. Not only is it transforming its force structure to meet the emerging demands of the 21st century, but it is also focusing on improvements in facility management. Through these improvements, the Army will enhance the quality of life of its soldiers and the capabilities of its installations as power projection platforms. The Army is making huge investments in new facilities such as barracks, strategic mobility infrastructure, and buildings to support mission and training requirements. It has also embarked on extensive revitalization efforts to upgrade the quality of many of its existing barracks and family housing. The military construction (MILCON) budget for new construction and revitalization in FY01 alone is $2.8 billion.

At the same time, the Army maintains a vast amount of real property at 1,800 locations around the world (including Reserve and National Guard sites) on about 14 million acres of land. This real property consists of nearly 163,000 buildings (including over 47,000 in family housing) occupying 1 billion square feet and averaging 40 years in age.

In its FY01 budget, the Army earmarked about $1.7 billion for real property maintenance. Although this funding is substantial (nearly 3 percent of the total budget), the Army finds that it can only afford the most essential maintenance. For example, for FY01, the Army projects that it can fund only 69 percent of its recognized real property maintenance requirements, despite the fact that its aging infrastructure continues to deteriorate.

To improve the value it receives for its construction and facility maintenance dollars, the Army initiated its Value Improvement Program. As part of this program, the Army asked the Logistics Management Institute to examine its facility construction and maintenance process and identify potential changes that will effect cost economies and other value improvements.

METHODOLOGY

In our study, we compared the Army's process with that of the private sector for delivering and maintaining three types of facilities: family housing, barracks (dormitories), and administrative buildings. We identified and analyzed cost differences between these facility management processes in seven locations: Fort Bragg, NC; Fort Drum, NY; Fort Hood, TX; Fort Lewis, WA; Fort Meade, MD; Fort Richardson, AK; and Fort Sam Houston, TX. We then ascertained the factors that drove cost differences. Finally, we recommended changes to the Army's process that would lead to cost economies and other value improvements.

To compare the Army's facility construction and maintenance process with that of the private sector, we took the following approach:

- We modeled the Army and private-sector processes. Since there is no single, universally accepted private-sector process, we constructed a generic process that incorporates best practices identified by practitioners and academic research.

- We collected cost and time data for the process models, focusing on data relating to the construction and maintenance of three facility types—family housing, barracks, and administrative buildings—at or near the seven installations under study.

- We compared the two processes, identified cost and time differences, and then derived the reasons for those differences.

For Army data, we relied on Army sources. For planning information, we used project justification forms, DD Form 1391s, from actual projects. For design and construction data, we used the Automated Management and Progress Reporting System (AMPRS) database and actual design drawings and specifications. For maintenance data, we used annual installation performance data.

We drew private-sector data from a number of sources. We used published data on design, construction, and maintenance from F.W. Dodge, R.S. Means, Whitestone, PSMJ Resources, the International Facility Management Association, the Building Owners and Managers Association, the International Development Research Council, and the Institute of Real Estate Management. We conducted two major surveys in conjunction with two professional organizations. Through the American Consulting Engineer Council (ACEC), we surveyed design practitioners on the costs of performing design projects for the Army. Through the Construction Management Association of America (CMAA), we surveyed construction practitioners on the costs of performing construction projects for the Army. We also interviewed designers, real property managers, and construction professionals in locations near four of the seven installations—Washington, DC; Seattle, WA; Anchorage, AK; and San Antonio, TX.

In addition to analyzing costs and cycle times, we assessed the attributes of quality and user satisfaction of Army facilities. We held a series of focus group meetings at the seven Army installations. In one set of meetings, we met with master planners, designers, and construction managers to discuss construction-related issues. In another set, we met with resource managers and maintenance staffs to discuss maintenance issues. In a third set, we met with soldiers, family members, and civil servants who lived or worked in facilities on the installation. In those meetings, we discussed and surveyed their views on facility quality from a user perspective.

THE PROCESS

From a macro-perspective, the Army's process resembles that of the private sector. Both can be viewed (and modeled) in corresponding sequential phases. We view the process in five phases:

1. *Planning*. During this initial phase, both the Army installation and our generic private-sector entity transform requirements or demands for new facilities into planning and financial justification documents. Both entities then seek project approval and project financing. Once a project is approved and financing is arranged, both entities proceed to the next phase, design.

2. *Design*. Both entities translate their requirements into detailed construction plans and specifications.

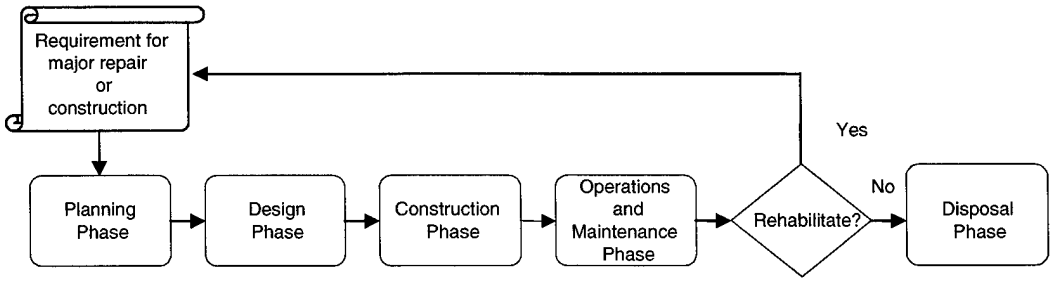
3. *Construction*. The construction plans and specifications are implemented.

4. *Maintenance*. Once a facility is built and occupied, maintenance begins. Both entities operate and maintain a facility throughout its useful life. At appropriate times during the maintenance phase, both entities determine whether they should significantly rehabilitate or dispose of the facility. A decision to rehabilitate the facility translates into a new requirement for either a major repair or renovation project, and the process recycles to the first phase.

5. *Disposal*. A decision to dispose of the facility leads to this final phase.

Figure 1-1 depicts the five-phase process. (Appendix A depicts the Army's process in more detail; Appendix B describes our generic private-sector model.)

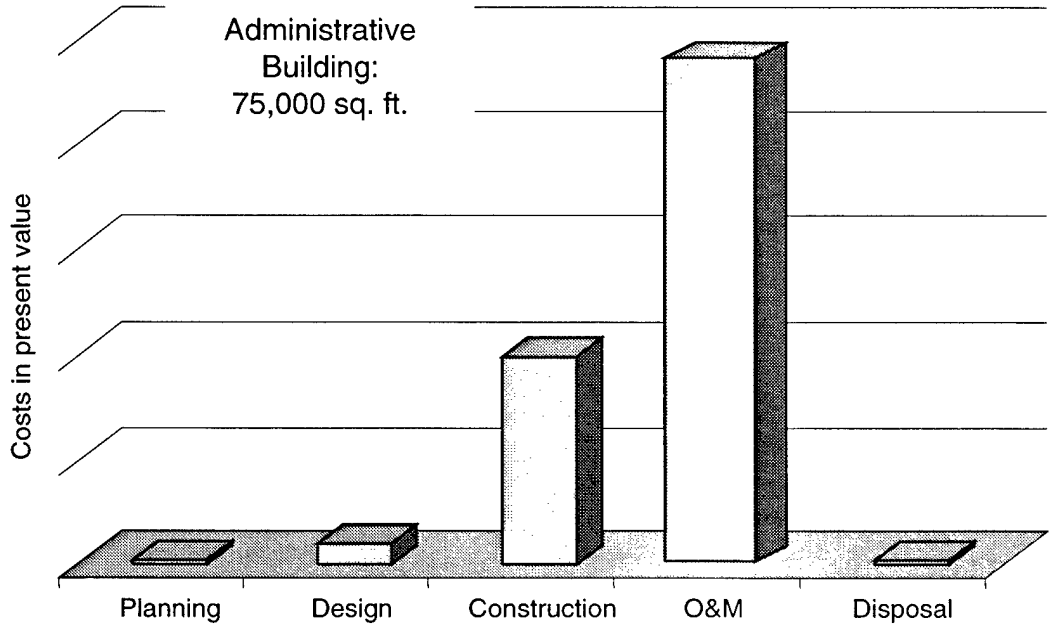
Figure 1-1. The Facility Construction and Maintenance Process



The costs for each phase can be generalized for a 50-year life cycle. Figure 1-2 depicts a typical cost distribution for the construction and maintenance of a prototypical 75,000-square-foot administrative building built to common standards. It

shows the costs in terms of net present value.[1] Operations and maintenance (O&M)—which costs about 2.5 times as much construction—is the most costly phase of the entire process. At the other extreme are planning and disposal, each costing between 1.5 and 2 percent of the cost of construction. The design phase falls between these costs, at 8 percent of the cost of construction.

Figure 1-2. Cost Distribution by Phase for a Prototypical Administrative Building



MEASURES OF VALUE

From a conceptual standpoint, value is a measure of utility or power to satisfy human wants and needs. In other words, it is the worth of something in terms of usefulness or importance. Value is frequently, but not always, expressed in terms of money.

In this study, we converted the conceptual view of value into something more concrete. We defined it as a function of (or dependent on) four factors: cost, time, quality, and user satisfaction. We then measured the factors in relation to the facility delivery and maintenance process. Finally, we established a set of criteria for assessing value improvements.

We measured costs and time quantitatively. For example, we identified construction costs in terms of cost per unit area (e.g., dollars per square foot) and time in terms of duration (e.g., months to complete construction). We measured quality and user satisfaction qualitatively.

[1] Net present value, in this context, is an equivalent measure of the sum of current and future expenditures after taking into account (i.e., discounting for) the time value of money.

To us, quality and user satisfaction address the same attributes from different organizational perspectives. The designer, construction manager, and maintainer (as the producers of facility management services) are as interested in quality as the occupants (as consumers) of the facilities that are built and maintained. We considered eight attributes for quality and user satisfaction.

- *Performance*. The primary operating characteristic of the facility, such as meeting work/shelter needs and providing water, heat, air conditioning, and ventilation.
- *Features*. The accessories and special additions that supplement the facility's basic functions.
- *Reliability*. The probability that the facility will operate as designed within a given period.
- *Conformance*. The extent or degree to which a facility meets established standards.
- *Durability*. The economic and structural life of the facility and its installed equipment (e.g., heating and ventilation system).
- *Serviceability*. When repair is required, the speed of repair and the competence and courtesy of the repair staff.
- *Aesthetics*. How a facility looks, feels, sounds, or smells—interior and exterior.
- *Other perceptions that influence judgments of quality*. The image, culture, and reputation of the Army reflected in the facilities.

Appendix C describes our user satisfaction survey and presents the results.

As criteria for assessing whether our recommendations would add value for the Army, we stipulated that value is improved when life-cycle costs are lowered, cycle times are reduced, quality is improved, or user satisfaction is increased.

REPORT ORGANIZATION

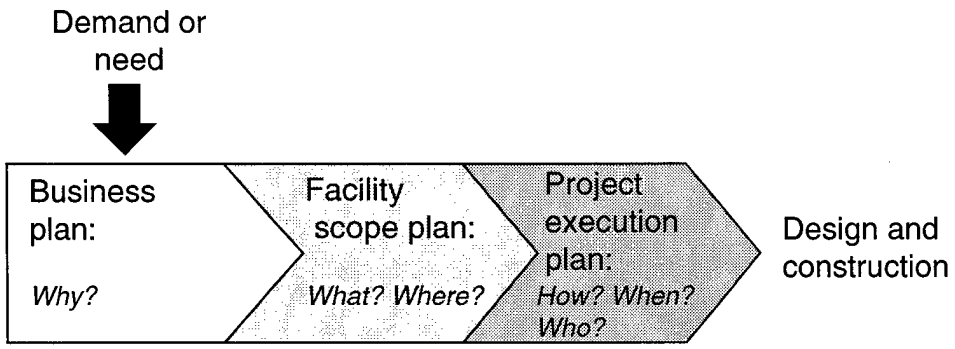
Following this chapter, we present our phase-by-phase analysis of the Army process. In Chapter 2, we describe the planning phase. In Chapter 3, we review the design phase. In Chapter 4, we examine the construction phase. In Chapter 5, we analyze the operations and maintenance phase. In Chapter 6, we consider the disposal process. We then present our major findings and conclusions in Chapter 7 and our recommendations in Chapter 8. The appendixes contain background information.

Chapter 2
Planning Phase

INTRODUCTION

The planning phase leads off our prototypical 50-year life-cycle facility process. This phase encompasses predesign activities that provide the justification and documentation necessary for project approval and funding authorization. Figure 2-1 shows the steps in a generic planning process.

Figure 2-1. General Steps in the Planning Phase



When a facility is demanded or needed, the planning process begins. The first task is developing a business plan that clearly identifies objectives, such as capacity demands, for the project. Market research and analysis is performed in the surrounding area to identify potential facility locations or alternate ways of fulfilling the requirement, as well as to consider supporting demographics and needs. After defining the objectives, the most important part of the business plan—the funding plan—is created.

After the project's business plan is completed, the project is assessed in detail, creating a facility scope plan. The site selection is finalized, preliminary design criteria are developed, and initial cost estimates are completed. Preliminary environmental investigations are initiated and regulatory and other legal issues associated with the site are addressed.

Finally, once a site has been selected, the project is authorized for completion. At this stage, a project execution plan is developed to formulate a preliminary project organization, establish a master project schedule, and set a contract strategy for the next phases of the project (i.e., design and construction).

ARMY PROCESS

For Army MILCON projects, the planning phase typically lasts 1 year. For major repair and renovation projects financed with Operation and Maintenance, Army (OMA) funds, this phase is usually shorter due to lesser authorization requirements. While generally following the steps shown above, the Army process is closely tied to the programming and budgeting cycle. The Army planning process is described in detail below (see Appendix A).

Requirements Determination

When a facility demand or need exists (i.e., requirements determination), as determined by master planning procedures in AR 210-20 (housing requirements are established by the Army Housing Requirements Program), the Army process begins. Requirements determination in the Army process is largely "rules-driven"; that is to say, the Army determines its requirements on the basis of a set policy or mission, which can be identified in one of three ways:

- *New mission identification.* Driven by Army policy (e.g., relocation of troops to a new installation).
- *Change in current mission.* Driven by Army policy or the need to upgrade to meet new standards (e.g., new or renovated maintenance facility to keep pace with equipment change).
- *Derived requirement.* The Army uses a software model, called Real Property Planning and Analysis System (RPLANS), which calculates installation facility requirements on the basis of a standard set of algorithms and the Army Stationing and Installation Plan (ASIP).

The real property master planning activity within an installation's directorate of public works (DPW), assisted by the installation real property planning board (RPPB), identifies requirements, or tenants or users of the installation submit them.

Project Development

Once a need or demand has been identified at the installation level, the DPW initiates project development to support the requirement. The Army's key development document for its construction program is DD Form 1391; it includes the following information:

- Project justification
- Programming cost estimate, developed in coordination with DoD guidance
- Analysis of deficiency

- Alternatives considered with related economics
- Functional requirements
- Criteria to be used
- Related acquisitions
- Utility impacts
- Environmental documentation
- Completed and required coordination actions.

The installation's master planners complete a 1391 for every proposed construction project and include it in management decision packages (MDEPs), which are approved through the planning, programming, budgeting, and execution system (PPBES). Due to the limited funding available for construction projects and the large number of requirements identified, projects with completed 1391s then compete at both the installation and major command (MACOM) levels for priority.

Project Competition and Certification

Once the installation's RPPB approves the project, the installation submits it to its MACOM, with an information copy to the U.S. Army Corps of Engineers (USACE) district or division, for competition among all MACOM projects. The MACOM uses the 1391 documentation to develop its prioritized construction list using the construction appropriation programming, control, and execution system (CAPCES). If the MACOM adds the project to the list, it formally forwards it to the USACE district or division. USACE reviews the project documentation for compliance with prescribed technical standards, criteria, and cost engineering requirements. Once it completes the project reviews and makes comments, USACE sends the 1391 back to the MACOM.

The MACOM then certifies the project by including a statement in the 1391 that all planning and coordination with appropriate agencies has been accomplished and project documentation is available. The MACOM certifies that the project is valid and requirements and scope are within Headquarters, Department of the Army (HQDA), guidance.

Project Approval for Appropriation

The next step in the process is to align the MACOM construction priority lists with Army objectives, priorities, and policies within the funding limits set for the program. To accomplish this task, the construction requirements review committee (CRRC), a subcommittee of the program and budget committee, reviews all

1391 project documentation to formulate the annual Army procurement request for construction.

This review takes place prior to the annual HQDA project review board (PRB). At the PRB, the MACOM formally presents the project. The PRB considers each project submitted by the MACOM. The PRB will either recognize the project requirement in the given year or defer consideration to a later program objective memorandum (POM) year. At the PRB, HQDA may recommend authorizing code 2 (concept design) or code 3 (parametric design).

PRIVATE-SECTOR PROCESS

In the private sector, the planning and design phases are inextricably linked. The organization begins preliminary design virtually at the start of planning.[1] It identifies potential projects on the basis of market opportunity or profit-making potential. The need or requirement triggers an investigation of potential projects. This investigation is followed by the selection of a development team. On the basis of the requirement and preliminary market analysis, the organization makes a go-no-go decision. If it makes a go decision, it starts preliminary design and site selection.

Because market forces largely drive the private-sector process, it has a greater incentive and agility than the Army process to discard projects on the basis of changing conditions or requirements. In the planning/design phase, there are at least three points at which a project may be dropped. The Army process does not have that same agility because the Army budget and project approval processes span a number of years and involve a large number of decision-making authorities. Thus, an Army project gains inertia as it moves through the planning, design, and construction phases as well as the POM process.

As in the Army, management (i.e., senior executives, board of directors, etc.) in the private sector has substantial oversight of the process. However, due to the demands of a highly variable market, fewer management players are involved, making the process less cumbersome and the approval period significantly faster.

COST

Estimating the cost of planning in the life-cycle process is a difficult task. Costs are associated mainly with the labor involved in project development and documentation. In the Army, as in the private sector, costs are generally not attributed to specific projects until they receive design approval. Rather, planning costs are considered overhead for the facility management function of the installation or organization.

[1] See Appendix B for a description of a generic private-sector process.

Army

For the purposes of this report, we estimate the cost of the planning phase in the Army process at 1.5 to 2 percent of the total MILCON budget. Two factors drive most of Army costs during the planning phase. First is the Army's programming and budgeting system. This highly centralized, intricate process involves all levels of the Army and helps it develop economically efficient allocations of its $70 billion annual budget among all its program areas, not just the $2.8 billion MILCON program. It also dictates the planning phase's cycle time since programming milestones and budget preparation deadlines are relatively inflexible.

Thus, during this planning phase, the installation identifies and justifies its MILCON request (i.e., the completed 1391). The request competes with scores of other requests for funding as it works its way up the chain of command through MACOM to HQDA. This justification process is required for requests for construction or major repair projects valued above established thresholds.

The other cost driver involves the facility-related policy from which the installations derive construction requirements. Some of these policies specify the number and type of facilities for different population levels. Other policies emphasize the Army senior leadership's priorities, such as building new daycare centers or renewing the barracks. When policies change, either from new design criteria or changing priorities, the installations respond accordingly and generate new MILCON requests.

Private Sector

The private-sector organization has cost drivers similar to the Army's. While it doesn't follow a formalized POM process, it must still justify the construction project, secure financing, and get approval from corporate headquarters to proceed. Thus, market and economic analyses are major events, which are costly and time-consuming. Moreover, corporate strategic policy may dictate specific requirements, such as having a distribution warehouse within a 30-mile radius of its retail stores.

FINDINGS AND RECOMMENDATIONS

Although the Army and private-sector project planning processes differ, especially in the associated drivers, elements of the private-sector approach can benefit the Army's process.

Improve the Requirements Development Process

The Army does not thoroughly define project scopes or develop accurate budget estimates early in the planning process. Consequently, it reduces the scope of some of its projects during the design phase so that construction costs do not

exceed poorly estimated program costs. The Army can rectify this problem by amending its requirements development process. In particular, it should increase the use of planning charrettes to fully develop requirements for selected projects. It should also incorporate parametric design cost estimates in its DD Form 1391 construction justification document submissions.

USE PLANNING CHARRETTES

A charrette is a meeting of involved parties to facilitate a review of a construction project. While typically used in the design phase, it has proven to be an effective tool during the planning phase of project development in defining a focused requirement. We recommend organizing planning charrettes for Army projects between installation and USACE area and district engineers early in the development process. In the current process, nothing prohibits this practice. However, installations do not employ planning charrettes because the cost would have to be funded from their already cash-strapped O&M account. Installations can't justify something—a seeming luxury—that is not required.

To successfully implement our recommendation, the authorization for planning and design (P&D) funds release to USACE must change. Currently, P&D funds cannot be released to USACE until after code 2 or 3 design has been authorized. If a small amount of P&D funding were to be released to the installation level specifically for this purpose, installations could hold planning charrettes for appropriate projects. The use of P&D funds could be justified if the USACE personnel attend the planning charrettes with the primary objective of supporting the preparation of parametric cost estimates—the complementary initiative for improving the requirements development process.

REFINE PROGRAMMING COST ESTIMATES

The Army relies mainly on tri-service cost estimating guidance to develop the programming cost estimate on the 1391. This guidance contains unit cost data, based on historic construction data for the most common facility categories, as well as size and location adjustment factors. The programming estimate is the basis for congressional project approval.

When estimates prove to be inaccurate, the Army must reduce the scope or obtain (i.e., reprogram) additional construction funding to meet the requirement. Because reprogramming is time-consuming, essentially going through another POM cycle, most projects are reduced in scope to meet the original estimate. This reduction burdens the construction contractor and designer in terms of change orders and modification to the work scope. For this reason, private firms often prefer not to bid government jobs or increase their profit margin as a contingency for such changes.

Not only does an inaccurate project estimate affect cost proposals for private firms for project construction, but it may also negatively impact the quality of the

finished product. While the original design may have been adequate for the requirement, a reduction in work translates into the omission of design elements in the construction phase. In our visits to Army installations, we heard anecdotal information about a gym in Texas being completed without a heating, ventilation, and air-conditioning (HVAC) system, and lower quality mechanical equipment being installed to meet a programming estimate. Improving the quality and accuracy of the original project estimate will reduce construction costs and improve the quality of the delivered product.

Integrate the Full Facility Cost When Planning

The private-sector takes a life-cycle view of its facility requirements and manages its cash flow accordingly. For example, it will create a long-term financial plan that considers not only the investment costs of building a facility, but also the revenues needed to maintain it (and cover any related debt service it may have). Once its facility is constructed, the organization aggressively manages its financial plan to ensure that maintenance is adequately financed.

The Army isn't taking a long-term financial management approach. Instead, it focuses on a 1-year budget horizon. Any consideration of maintenance requirements in an economic analysis justifying a MILCON request is not connected to future maintenance budget plans. Thus, the installation requester has no meaningful basis for determining whether the installation will be able to afford the maintenance of a new facility, once it is constructed.

For the private-sector organization, lacking a firm basis for determining whether it will likely be able to afford maintenance is a deal breaker. It won't be able to get financing, let alone approval from corporate headquarters. Yet the Army, with a track record of perennially underfunding its facility maintenance accounts and no plans to change that condition, continues to add new facilities to its inventory. Then it wonders why its physical stock is in such poor condition.

Decentralize Planning

Private-sector companies are decentralized in their planning for projects, so decisions are made at the level most familiar with market conditions. Even in large corporations with land holdings in many parts of the country (or the world, for that matter), decisions on individual construction projects are not normally made at corporate headquarters. Instead, they are made at regional or lower levels.

The Army's degree of decentralization is far more limited. Installations can decide to finance major repairs and minor construction projects from their O&M accounts only when the project values are beneath the thresholds mentioned above. Although the current O&M threshold increased from $500,000 to $3 million in December 1999, many senior installation-level DPW staff members are unaware of the increase. As a result, they repeatedly mentioned to us that this threshold is too low and leads to inefficiently sized repair and renovation projects.

They said that raising the decision threshold for projects financed from an installation's O&M account would allow it to meet some of its facility needs quicker and more efficiently. They stated that the installation's facility condition posture would improve under this approach, even if the installation's O&M budget weren't increased commensurately with the increase in the threshold level.

The funds available under this threshold are from the O&M account and can, therefore, only be used for operations, maintenance, renovation, and minor construction. As a result, the raising of the threshold directly encourages installation managers to maintain and continuously recapitalize their facilities as opposed to constructing new facilities. This has the potential to reverse the trend of adding new facilities to inventory that they have a limited ability to maintain.

Raising the threshold to $3 million is an effective incentive for improving the management of installation facilities. It encourages installations to fund rehabilitation projects, thus increasing the life cycle of their assets. It also expedites the delivery of much needed facility maintenance and enhancements, reducing the overall cost of the approval process.

While increasing the threshold to $3 million increases the authority of the installation or MACOM manager, it does not significantly decrease the level of HQDA and congressional oversight. We analyzed the data available in the AMPRS database from 1990–98 and found that a threshold of $3 million would have allowed local decision-makers to approve 92 percent of the projects in the database. However, these projects only accounted for 43 percent of the expenditure. A snapshot of 1998 data alone presented results of 89 percent of projects approved locally accounting for 35 percent of the expenditure. Thus, the $3 million threshold allows the installations greater control over the life-cycle investment strategy of their assets without impacting the level of external oversight for the majority of the construction funds available. However, to take full advantage of this incentive the Army must increase the awareness of the threshold increase at the installation level.

Improve Real Property Portfolio Management

In the private sector, real property assets add value to their owners, either from their moneymaking potential or by the service they provide. As such, facilities are continually under financial scrutiny. Once a property is seen as a liability, an organization disposes of it. In the Army, this type of overarching life-cycle facility portfolio strategy does not exist because of the separate funding authorizations for facility construction and operating budgets. To the master planners who oversee the real property, with no life-cycle bottom line to watch, it essentially becomes a free good once construction is complete; there is no motivation for property disposal. In fact, there's a disincentive to dispose: the loss of O&M funding, allocated on the basis of facility square footage. Performance measures for installation real property management should include a measurement of facility usage and cost.

Chapter 3
Design Phase

INTRODUCTION

In most cases, the design phase of a project directly follows the planning phase and comprises three distinct subphases: preliminary, conceptual (or parametric), and final design. During the design process, the customer requirements established during the planning process are developed into a complete design package that includes the plans and specifications needed for construction. From a total life-cycle cost perspective, the design phase represents only a small portion a facility's total cost, but the design's impact on the total life-cycle cost can be enormous.

The process of design and review passes through several layers as the conceptual design evolves and proceeds from the USACE district through the installation and MACOM, where it is reviewed for accuracy in capturing client requirements. Once complete, the MACOM forwards it to HQDA, where the staff of the office of the Assistant Chief of Staff for Installation Management (ACSIM) reviews it (collectively with all other projects) and places it in the budget proposal for congressional authorization and appropriation. If approved, final design begins. This effort, which results in construction contract documents, has a comprehensive review system of checks and balances that includes client requirements and biddability, constructibility, operability, and environmental (BCOE) reviews.

Depending on the programming cycle, which is determined by congressional oversight, the design phase can take anywhere from 17 to 29 months, including the preliminary or predesign activity (referred to as Code 1). Much of this time is spent waiting for the next decision cycle and does not necessarily reflect the amount of time required to produce a design.

In-House Design

For the MILCON program, although some projects are designed in-house, contracted architect-engineer (A-E) firms do most of the design work. USACE typically limits the design of its MILCON programs by in-house personnel to 25 percent of the total program. Having this work done in-house accomplishes multiple objectives:

- It keeps the USACE design skills current.
- It enables the in-house team to maintain current expertise in reviewing work accomplished by contractors, which allows USACE to better

respond to urgent customer projects that have no time to competitively bid and hire an A-E firm.

- It allows the use of in-house capability to fully realize cost savings when site-adapting designs (since A-E firms may insist on replicating portions of the design because of liability concerns).

- It provides flexibility in managing the districts' professional work force. During periods of reduced construction program funding, district offices are able to shift a greater portion of the work to the in-house work force, thereby maintaining in-house capability and expertise.

The chief of the district's engineering division usually determines which customer projects USACE designers will accomplish and which will be done by an A-E firm. This determination is based on the expertise required, availability of in-house staff, whether the design is a standard or repetitive design, and other factors.

Outsourced Design

Private-sector A-E firms accomplish 75 percent of the engineering and design work assigned to USACE. For FY00–01, the Army will place an estimated $70 million design workload for MILCON with these firms. The firms often possess more extensive technical capabilities and staffing than can be maintained within USACE staffing limitations. The nature and volume of work assigned to A-E firms varies widely and includes, for example, design of complex medical facilities, research and production buildings, and airfield installations. In addition, A-E firms typically perform the necessary project-related geotechnical studies and cost estimates.

DESIGN PROCESSES

In this section, we discuss the Army and private-sector design processes.

Generic Army Design Process

The project delivery process is made up of the following steps: project conception, development and funding identification, refinement, execution, delivery, and closeout (see Appendix A).[1] The major subphases of the design phase of the process include preliminary planning; securing A-E services, as described above; and final design. The combined subphases, from preliminary through final design, typically take at least 2 years.

[1] The time line in Appendix A shows the typical process for execution of a project but does not take into account changing priorities and unforeseen events.

PRELIMINARY DESIGN

After a project has been planned, submitted, and approved as part of the POM proposal by HQDA, the preliminary design phase begins. The USACE district initiates the preliminary design activities. Information from the planning phase identifies the project requirements and includes the following:

- Acquisition plan
- Project milestone schedule
- Project budget
- Quality requirements
- Risk assessment plan
- Project team identification, roles, and responsibilities.

USACE or an A-E firm, as described previously, will perform the design of the project.

DESIGN SERVICES

Typically, USACE assumes design responsibilities for projects when a standard design already exists or the design is repetitive. In these instances, sometimes only a site verification (and possibly a site adaptation) is required. But often a complete design package is needed. Since design work for these projects is often completed by another firm, A-E firms selected through a competitive bid process have expressed concern over being asked to certify another firm's design. This certification creates a liability that design firms are rarely willing to assume. Since USACE is less concerned about these liability issues, it is more cost-effective for it to assume this responsibility and perform the validation of the existing design in-house. Typically, the A-E performs the work that requires major changes to standard or repetitive designs and unique design work.

When A-E services are required, USACE develops evaluation criteria to provide quantitative and objective measures used in the review and evaluation of A-E proposals. It also prepares a source-selection plan, of which the evaluation criteria are an integral component. These are contained in the statement of work (SOW), which also contains the definitive project requirements and schedule for implementation. A synopsis of the SOW is prepared and used in the notice published to solicit participation by qualified A-E firms, giving them the requirements of the project as well as the evaluation criteria used by USACE.

After the notice is published, interested A-E firms prepare qualifications statements specifically targeted to the project's objectives. During this time, the A-E firms may ask questions on any aspect of the project to enable them to properly

target their approach and qualification summary. USACE uses these statements to evaluate their qualifications. They then rank and develop a "short list" of qualified firms. The A-E firms on the short list make oral presentations and participate in interviews regarding their capabilities and approach to the project.

USACE prepares a final ranking of A-E firms on the basis of the results of the presentations and interviews. Final selection of the A-E occurs on the basis of this final ranking and review of supporting documentation. USACE then issues a request for proposal (RFP) to the A-E firm to develop a complete design proposal. After the design proposal is submitted, USACE accepts it or requests modifications. Once the proposal is accepted, USACE performs a cost and technical analysis, including the evaluation of hours required for the project and associated specialty expertise.

USACE may perform a financial audit, through the Defense Contract Audit Agency (DCAA), when a review of the cost analysis indicates it would be appropriate or when the cost exceeds $500,000.[2] The verification of project costs and the technical analysis form the basis for developing a prenegotiation objective and are essential components in the negotiation with the A-E firm. The negotiation typically includes the hours required to design the project by type and discipline, associated direct and indirect costs, and period of performance. It may include identification of deficient areas, as well as further clarification of project requirements and expectations.

USACE determines whether the price and schedule for completing the project are fair and reasonable. Upon validation of the price, USACE compares the design costs with the budget targets for the project. If funding in the proposed budget is insufficient, USACE refers the issue to the Army installation to determine whether additional funding is available. The Army may modify the design, seek additional funding from Congress, or reprogram the project. The Army issues a notice to proceed and restarts design services upon confirmation that funding for the project has been approved.

A planning charrette—including the project team, facility and functional design staff, and specialized project expertise, as appropriate—can be conducted with these combined inputs to refine the design criteria and provide the maximum input and accuracy to the preliminary design. However, because of lack of funding, USACE does not typically perform planning charrettes. The installation must take funds from O&M if they hire USACE to perform this work. This is typically not feasible due to already constrained O&M funding. However, ACSIM headquarters has completed a pilot program that validated the usefulness of these charrettes in refining design requirements.

At its option, USACE may perform value engineering upon finalizing the design criteria in order to achieve the highest quality while meeting the functional,

[2] Defense Federal Acquisition Regulation Supplement, Part 215.404-2.

schedule, and budget limitations of the project. After USACE and the installation review and approve the 10 percent parametric design, the A-E provides input for the final budget estimate for constructing the project. This estimate is used to update the budget estimate in the POM proposal, if necessary, and HQDA must approve it before initiation of the final design subphase. The approval process—from the time USACE submits the project design and cost to the installation until congressional appropriation—takes from 3 to 12 months. During this time, the design process stops.

FINAL DESIGN

Upon final approval of the project, HQDA notifies USACE to proceed with the final design. Failure of the project to be approved results in further delay or indefinite deferral due to other priorities. This delay may result in the loss of the design.

Project approval allows the project to proceed to approximately 60 percent design. The 60 percent design stage sometimes includes a design review. The A-E firm modifies the 60 percent design, if necessary, before proceeding to the final design. Upon completion of the final design, a review of the design for BCOE compliance results in changes, as necessary, or proceeding to the final design review and approval. USACE directs an independent cost estimate before final design review of the project.

The final design review considers the BCOE reviews, the independent cost estimate, and appropriate installation input. When USACE approves the final design, either the A-E firm or the USACE project engineer prepares plans and specifications used in the advertising for the construction phase. The USACE project manager ensures that the project remains within budget constraints or halts the project until funding issues are resolved.

Private-Sector Model

The private-sector model has the same steps as the Army process (see Appendix B). However, some essential differences affect how the process works. For example, private-sector firms often have preferential arrangements with A-E firms or the capability to perform this work internally. This situation allows them to have continuity in design expertise, well-established working relationships, and a clearer understanding of roles and expectations among the project team members for project execution. In addition, these relationships can often result in lower design costs due to the ability to reuse various aspects of existing designs, the willingness to certify their own previous designs for use in another application, and the likelihood of being able to strategically plan their workloads to accommodate future project needs.

Because of these preferential arrangements, as well as the ability of private-sector management to be more responsive to budget and scope changes, they can often

go from preliminary to final design in less then a year. Due to fast-tracking of private-sector contracts, the design and construction phases overlap, which eliminates even more time from the design/construction cycle. For example, the A-E is completing the building's structural design as the foundation work gets underway and is completing the interior design and finish schedule as the structure and shell are being assembled. This scenario is particularly common in design-build projects but can also occur (to a lesser extent) on design-bid-build efforts.

Repetitive or standard designs reduce design costs even further depending on particular site conditions, as discussed above. The preferential arrangements with A-E firms can include using one or several firms for the design work for which rate structures and working relationships are established in advance. This collaboration permits the resource availability to meet project workloads for several years in advance. The A-E firms come to rely on these recurring projects and typically are motivated to develop effective working relationships and provide high quality work.

The private-sector model uses the business plan for the project to monitor project success. If the major components of the business plan change or the project scope exceeds the budget, the design is reviewed and modified, as appropriate. Since the interest charges on the financing for the project are an essential measure in terms of the project success, any significant delay in the schedule can result in the project becoming uneconomic. Firms select projects on the basis of their expected profit, so every reasonable effort is made to fast-track project execution. Thus, the project team makes every effort to correctly capture client requirements from the beginning and to minimize design changes.

COST

USACE Cost Drivers

A subaccount of the MILCON appropriation, referred to as the planning and design (P&D) account, funds services required for the planning and design of MILCON programs and projects. Funds in this account pay for services provided by government in-house engineering and design personnel and by private A-E firms under contract to USACE.

The P&D account pays for most of the design and engineering services required before a construction contract is awarded but after a project has been authorized for design. In addition, certain engineering and design services required after contract award receive funding from the P&D account. Project design may require services like soil borings and topographic surveys, which appropriately receive funding from the P&D account. The installations and their MACOMs are required to fund all planning done before design authorization. Master planning, alternative site planning, and development of project requirements are typically funded from OMA or other installation funds.

Statutory Limitations and Constraints

Title 10, Armed Services Procurement Act of 1947 (10 U.S.C. 4540), imposes a statutory limit of 6 percent on A-E services related to public works or utility projects. The A-E services subject to this limitation are the preparation of "designs, plans, drawings, and specifications." Services not included in this limitation, but necessary for the preparation of a design, include boundary, topographic, rights of way, utility easement surveys, subsurface explorations, cost estimates, and travel costs. If solely in-house forces design a project, the 6 percent limitation does not apply. Since additional services are required for each construction project, the total P&D funds required will nearly always exceed 6 percent.

The P&D account is used to fund design-related functions, as stipulated by Title 10 U.S.C. 2807. These functions include the A-E services and construction design required for site investigation and survey, development of design criteria, cost estimating, plans and specification preparation, special studies (including value engineering), management and administration of design contracts, and the preparation and reproduction of contract documents. However, the cost to develop initial project requirements is typically drawn from installation O&M funds.

The related costs required for modifications to construction contracts are also funded from the P&D account. An exception is projects for new family housing, which typically use the turnkey method of contracting. Engineering and design services—such as detailed construction layouts, as-built drawings, surveys for record purposes, and pavement evaluations—required by the construction contractor to fulfill the contract are funded as part of the construction contract.

Data Sources

We based our analysis of USACE data on projects from the AMPRS database.

We obtained the raw data for private-sector design costs from the annual survey sponsored by the *Professional Services Management Journal (PSMJ)*. The survey volume, *Fees & Pricing in Design Firms 1999*, contains detailed cost information by type of firm, type of project, and level of service. The databases summarized in this report were accumulated from its annual survey of over 213 firms, each presenting information on multiple construction types.

These data were used to develop "full-service" cost comparisons, which is to say the private-sector data reflect the cost to provide the same services that USACE provides. Many private-sector design firms typically do not provide the same level of service that USACE provides. This is, in part, because many owning firms ("owners") perform some of these services, such as funds control and programming, themselves.

Cost Comparison

On the basis of techniques developed in an earlier LMI study,[3] Table 3-2 compares the full-service planning and design cost factors for MILCON with private-sector factors. We determined the cost factors shown by dividing the cost of adjusted P&D costs by the total construction contract amount.

Table 3-1. Military Planning and Design—Construction Cost Ratio Comparison

Military projects	Private sector			USACE design costs	
				Historic	1995–97
	25th percentile	Mean (%)	75th percentile	Mean[a] (%)	Weighted average[a] (%)
Military Construction, Army	6.6	8.3	10.7	8.0	7.3
Operations and Maintenance, Army	9.9	12.1	14.1	9.0	8.1

[a] Historic USACE design costs are based on the last available comprehensive USACE-wide data set. The 1995–97 USACE weighted average design costs are derived from a subset of USACE data and do not necessarily reflect USACE-wide cost experience, but are consistent with historic USACE design costs. The unavailability of a current USACE-wide data set is the result of a gap caused by the discontinuance of AMPRS and the delay of the full-scale implementation of PROMIS, which will be the source for USACE-wide project information in the future. The historic USACE design costs are the best indicator of actual current USACE experience, and we have used them as the basis for comparisons.

We compare the mean USACE cost factor for each customer with the range of comparable private-sector projects. The 25th percentile is the point in the range below which 25 percent of the projects cost less, while the 75th percentile is the point above which 25 percent of the projects cost more. Project costs vary significantly.

Cost performance between the 25th and 75th percentiles is reasonable although not necessarily efficient. None of the USACE cost factors exceed the private-sector 75th percentile, and all categories are less than the mean. One of the two categories is even less than the private-sector 25th percentile. Therefore, Army design-construction cost ratios compare favorably with the private sector.

Other Factors

A number of other factors affect a project's design costs. Carefully developed design documentation—essential for planning, design, and construction of a project—is even more valuable over the life of the project. These design bases, corresponding computer-aided design and drafting drawings, geographic information system databases, and operating manuals are valuable assets for facility O&M

[3] Logistics Management Institute, *Military Construction Planning and Design Funding Requirements*, Report AR001R1, James L. Hathaway, Eric M. Small, and Jeffrey Hawkins, November 1990.

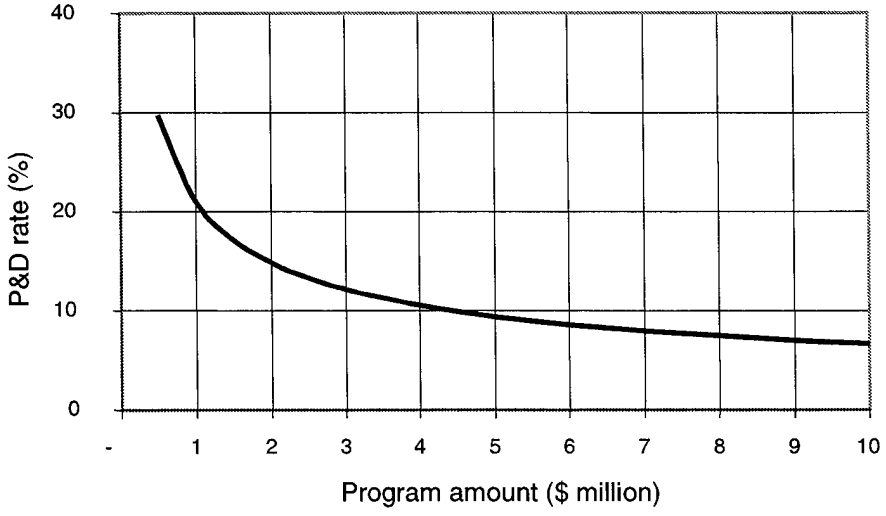
once it is in use. In addition, comprehensive facility documentation saves considerable time and money throughout the life of the facility on complex repairs, replacements, and modifications.

The regulatory requirements that affect the private sector also affect the costs of design for MILCON, including heavy equipment and crane certifications, seismic codes, environmental regulations, building codes, and flood plain issues. However, the federal government imposes additional regulatory requirements (restrictive technical and material specifications) on its design contractors and in-house design efforts. The regulatory clauses generally fall into four categories: socio-economic, cost control and accountability, business protection, and labor statute. LMI, in conjunction with the ACEC, recently conducted a survey that attempted to capture the additional cost burden created by compliance with federal contracting requirements. On the basis of the average response, the government pays an additional 6 percent as a result these requirements. Appendix D contains the complete results of the survey.

Cost Model for Specific Projects

As documented in an LMI report,[4] Figures 3-1 through 3-3 show the P&D rate curves for various construction projects. Again, we obtained the data from the AMPRS. The curves demonstrate the direct relationship between planning and design rates and project amount. Administrative and barracks facilities that approach $10 million typically have P&D costs at or below 6 percent. Family housing has a much lower P&D rate because they use design-build contracts and most of the design costs are included in the construction packages.

Figure 3-1. Administrative Facilities P&D Rate Curve—P&D = 210.097(PA)$^{1/2}$



[4] Logistics Management Institute, *Improving Management of Military Construction Planning and Design*, Report CE006R1, James L. Hathaway and Jordan W. Cassell, October 1991.

Figure 3-2. Family Housing Construction P&D Rate Curve—
$P\&D = 37.212(PA)^{1/2}$

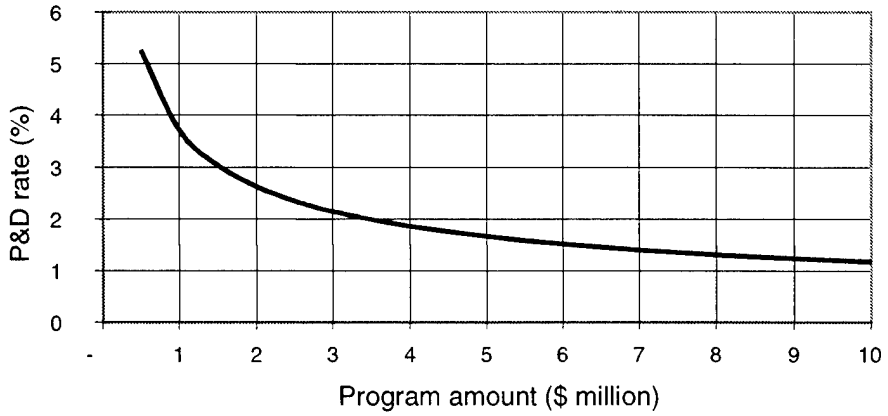
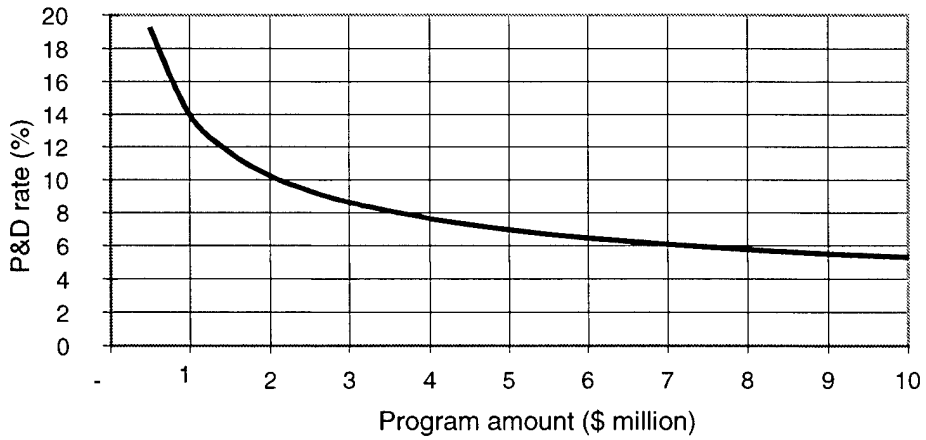


Figure 3-3. Unaccompanied Personnel Housing Construction P&D Rate Curve—
$P\&D = 127.177(PA)^{1/2} + 1.2698$



TIME

For the Army, the programming cycle drives the time required to complete design and start construction. As previously mentioned in the design process discussion, the design workflow is interrupted because it is tied to congressional appropriation. This interruption—in addition to the multiple layers of review, input, revision, and approval to which most Army designs submit—adds significant time to the process. It takes from 15 to 27 months from the start of conceptual design to the beginning of the construction process, depending on how well the completion of the design process is synchronized with the approval of construction funds.

In contrast, the private sector is not constrained by the same layered review and congressional appropriation process. Market pressures and the profit motive drive the time required to produce designs. Accordingly, it typically takes the private sector less than half the time to bring a design to completion. In addition,

overlapping the design and construction processes by phasing elements of the project can shorten the full project delivery time even further.

DESIGN QUALITY

Quality is an essential characteristic of successful project design. Quality reviews during various stages of the project (which include the customer to ensure the integration of client requirements) and reviews that consider BCOE issues are critical for accurately matching project requirements and creating a coordinated contract document package. In addition, since the quality and life-cycle costing of various design features is critical in identifying, monitoring, and controlling costs of a project after placing it into service, life-cycle performance and quality considerations merit careful attention.

The quality of a facility should be consistent with its intended use. The private sector gives careful attention to providing high quality in areas where there are significant life-cycle returns. This is particularly true in the area of O&M costs. Correspondingly, lower quality is provided in areas where O&M costs are not a factor. For example, lighting fixtures in the private sector are aesthetically appealing, energy efficient, and inexpensive. A more expensive fixture does not reduce O&M costs and, in fact, may increase them because it is not energy efficient and expensive to replace.

A study devoted to capturing the characteristics that influence the process quality in the life cycle of buildings identifies factors that affect quality in the design phase.[5] The most important is the "cooperation of parties" because an effective design process translates client needs into a complete design. Many parties are involved in the process of converting user requirements and conflicting inputs into a functional and aesthetically acceptable building. Success depends on effective teamwork between designers and between the design team and the client.

The second most important factor (in the same study) affecting quality is the project specifications. Specifying higher quality products should produce a higher quality building. The perception is that the Army specifies a level of quality that is, on average, slightly higher than the industry norm. Although some anecdotal evidence supports this perception, actual data are more difficult to capture. The Army strives to design buildings for longer useful lives. It specifies finishes, particularly in administrative buildings and barracks, intended to provide better then average service.

In an attempt to identify differences between the quality specified in private-sector and Army projects, we compared identical specification sections from the private-sector and Army specification "libraries." We compared specific sections of MASTERSPEC (owned by the American Institute of Architects) with the

[5] David Arditi and H. Murat Gunaydin, "Factors That Affect Process Quality in the Life Cycle of Building Projects," *Journal of Construction Engineering and Management*, May/June 1998.

USACE *Guide for Specifications* (or CEGS), focusing on the following finish sections: drywall, carpeting, steel doors, joint sealants, and painting.

Overall, the quality prescribed was similar. This similarity is due, in part, to the range of quality each specification guide is designed to allow. A few differences, however, suggest that the low end of the quality range specified by the Army may be slightly higher then the low end for MASTERSPEC. In the carpet section, CEGS had higher minimum carpet standards in terms of performance. In the section on painting, MASTERSPEC allowed an option of applying fewer coats than CEGS, and CEGS required a slightly higher minimum application temperature.

In general, we found that CEGS had more references to government and industry specifications and had greater submittal requirements. According to contractors, these requirements carry an additional administrative burden. The MASTERSPEC also has several distinct features:

- Each section includes references to related sections that provide a useful means of determining the interrelationships between work elements.
- It suggests the use of mockups for finish work, a useful tool for bridging any gaps between the design and end-product.

USACE considered using commercial specifications in the past. It would be a cost-efficient method of simplifying submittal requirements and would minimize the cost of maintaining CEGS. We encourage their adoption, but some specification sections unique to CEGS and to USACE work would need to be retained.

USER SATISFACTION

LMI's user satisfaction surveys had mixed results but indicate several characteristics of end-user perceptions of Army facilities. Overall, the average response mildly agreed with positive statements about the facilities. The range of responses for reliability and serviceability varied, indicating considerable differences in functional performance of the buildings and level of O&M service provided. However, the responses are internally consistent and portray a generally positive attitude toward Army facilities.

The features attribute received a consistent score. From a design standpoint, end-users were satisfied that the facility had the supplemental features they expected. It appears that designs typically meet end-user requirements in terms of features. In addition, there were no average negative scores for conformance of facilities to Army standards, which confirms that facilities conform to Army standards, or at least the end-users' perception of them.

FINDINGS

We group our findings into four topics, which we discuss in the following subsections: cost drivers for design, design quality and its impact on O&M costs, the design-build procurement option, and standard designs.

Cost Drivers

The private sector sees MILCON as "overdesigned." In some ways, the Army has higher quality standards than the industry norm. For example, it uses heavier foundations and cement masonry units (concrete block) for corridor walls. In contrast, we received multiple complaints regarding the quality of installed mechanical equipment, such as HVAC systems.

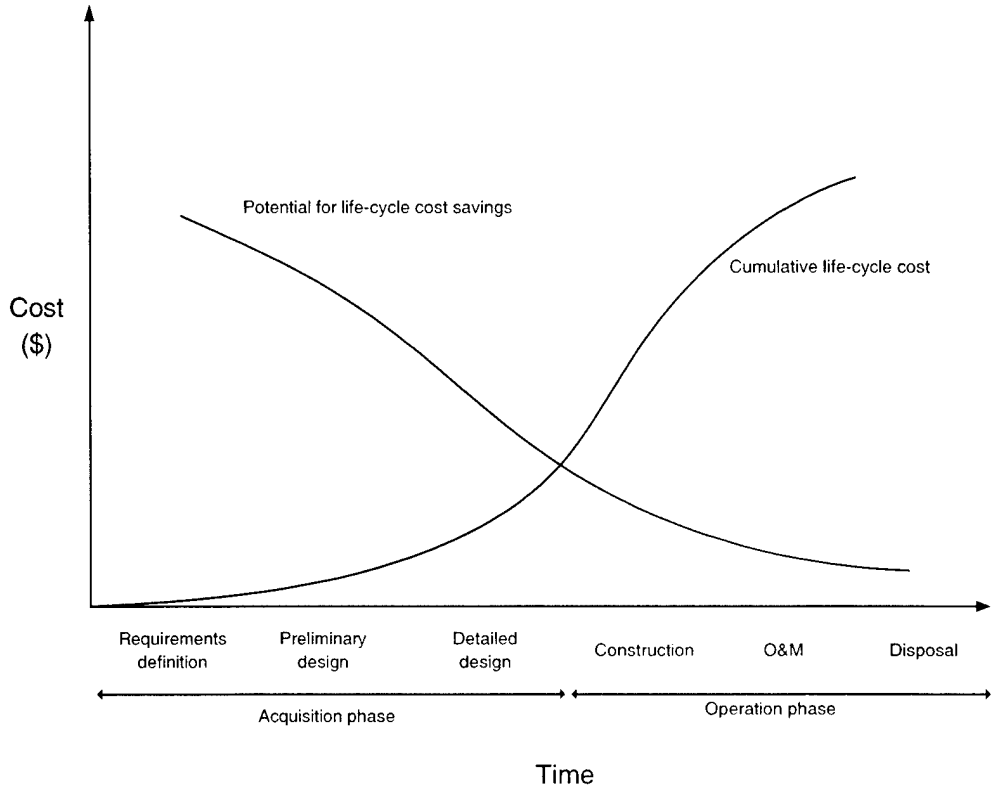
Also, the high tenant turnover rate at Army installations—driven by the regular reassignment of personnel married with the long programming cycle for appropriations—caused a high rate of user-initiated changes. In other words, it is difficult to accurately capture end-user requirements because the end-users are changing more quickly then the programming cycle.

Design Quality

Although the Army performs life-cycle analyses to determine the most cost-effective designs, separate appropriations fund design/construction and O&M. The division of appropriated funds places design priorities in conflict. Ideally, the designer would like to achieve a design that minimizes operational costs over the facility's life cycle, but given the pressures to reduce costs within a limited budget, O&M life-cycle considerations are frequently relegated to secondary status. When cost is an issue, quality suffers. The separate funding sources, in effect, create a barrier to effective utilization of resources.

As Figure 3-4 illustrates, the highest potential to realize life-cycle benefits occurs at the beginning of the planning stage and decreases gradually through the design, construction, and O&M phases. Adequate design funding would allow the design to target maximum cost-benefit in terms of cumulative life-cycle costs.

Figure 3-4. Life-Cycle Cost Model



Army installation O&M personnel complained that design skimps on mechanical space and equipment location, limiting access and making mechanical equipment difficult to service and more costly to maintain. Another major complaint was the quality of the installed mechanical equipment.

Two factors contribute to the poor quality:

- Designers must constantly wrestle with quality and cost considerations. Restrained by the 1391-programmed amount, designers will frequently lower the level of quality specified to keep within budget. The pressure on costs has been increased with the recent move to eliminate contingency allowances from budgeted costs.

- Because the vast majority of contracts are let to the lowest bidder, the contractor has little incentive to provide a high-quality end product. It has contracted to meet the minimum quality consistent with the specifications and no more. This shortcoming of the low bid, or design-bid-build, process leads to our next finding concerning the potential benefits of using design-build.

Design-Build

In the design-build delivery method, the owner selects a single contractor to both design and build the project. Upon completion of construction, the owner assumes responsibility for O&M.

Currently, about 5 percent of Army MILCON contracts use the design-build method. However, USACE leadership and ACSIM have exerted considerable pressure to increase its use. USACE has a current initiative for increasing the use of design-build contracts to a minimum of 25 percent of the total construction program amount for FY02. This increase follows the trend in the private sector.

The Design-Build Institute of America (DBIA) evaluated 12 market sectors and found that the number of design-build contracts had increased 105 percent from 1995 to 1996.[6] *Engineering News-Record* recently found that the top 400 contractors currently perform 22 percent of the $145 billion in annual construction placement using design-build contracts.[7] Moreover, DBIA estimates that 50 percent of all work will be contracted using the design-build method within the next 5 years.

Benefits gained by using design-build are fueling the trend. Among these are reduced cost, faster construction, and total project delivery. Some research indicates that the separation created by traditional contracting methods causes 30 to 50 percent of the wasted time and resources in the industry.[8]

A study performed in 1998 by the Construction Institute of America (CII), along with Penn State University, DBIA, and 12 industry partners, compared project delivery systems on 351 projects in the public and private sectors.[9] The advantages of design-build over design-bid-build and construction management at risk (CM@R) provide a compelling argument for using design-build (Table 3-2).

Table 3-2. Design-Build Comparisons

Comparison	DB vs. CM@R	DB vs. DBB
Unit cost	4.5% less	6% less
Construction speed	7% faster	12% faster
Delivery speed	23% faster	33% faster

Note: DB = design-build; DBB = design-bid-build.

[6] Michael D'Alessandro, "Strategies for Successful Design-Build Project Delivery," *PSMJ Best Practices* [cited October 2000]. Available from http://www.psmj.com/html/articles/strategies_for.htm.

[7] Tim Grogan, *Engineering News-Record*, 9/18/2000 [cited October 2000]. Available from http://www.enr.com/news/enrbl264.asp.

[8] Elaine S. Silver, "Being All Things, Tackling All Tasks," *Design-Build*, December 1999.

[9] Victor Sanvido and Mark Konchar, *Selecting Project Delivery Systems*, Project Delivery Institute, 1999.

In a comparison of traditional design-bid-build and design-build project performance on MILCON projects, the use of design-build reduced cost growth by 2 percent and decreased the percentage of change orders caused by design deficiencies from 42 percent to 9 percent.[10]

Some additional advantages of design-build include:

- *Single point responsibility.* It eliminates the owner's role in arbitrating disputes between the architect and contractor. To solve design and construction problems, the architect and builder team together because, contractually, they work for the same entity. The owner can focus on scope requirements and timely decision-making rather than on coordinating the architect and builder.

- *Quality.* Single-source responsibility, inherent in design-build, serves as motivation for quality and high performance. The design-builder commits to producing an error-free design. This arrangement contrasts with the traditional design-bid-build approach, where the owner warrants the quality of design to the contractor. The traditional approach requires restrictive contract language, audits, inspections, and, frequently, legal action to ensure project quality.

- *Improved risk management.* The performance aspects of quality, cost, and schedule are defined. Risk and responsibilities are evenly distributed and managed by the party best suited to manage that risk. Change orders because of "errors and omissions" are virtually eliminated because the design-builder has the responsibility to meet a performance specification that requires developing drawings and constructing a complete and functional facility.

However, no single project delivery system is appropriate for every project type. Design-build is not necessarily the best vehicle in every given situation. Client risks involved in using the design-build process include the following:

- *Complexity of the process.* Owners need in-house personnel with expertise in preparing and administering design-build RFPs and contracts.

- *Challenge of converting owner needs to performance-based language.* Preparing a performance specification comprehensive enough to ensure compliance while avoiding overly restrictive requirements that inhibit creativity in design takes skill and experience. The key is to identify requirements in performance terms and relate them to industry standards. These performance terms permit flexibility in the design concepts of firms

[10] Major Jim Pocock, United States Air Force, *Comparison of Traditional, Traditional with Partnering, and Design-Build Performance*, Thesis, University of Illinois, Department of Civil Engineering, 1995.

responding to the RFP while clearly fixing responsibility on the design-builder for performance.

Standard Design

Standard designs are predetermined criteria that address space allocations, spatial arrangements, energy conservation, sustainability requirements, quality-of-life issues, O&M cost items, and operational working relationships. The use of standard design criteria is the beginning point of the design process. They offer guidance on the characteristics that provide the basis for the square footage and spatial arrangements required. They also address the quality of life and O&M expenses for the facility.

Use of standard designs—balancing user and technical considerations with full knowledge of life-cycle costs and benefits—ideally results in a facility that is simpler and cheaper to design, construct, and operate. In general, USACE provides design-standard guidelines that dictate roughly 10 to 15 percent of the design content depending on the building type. These mostly take the form of typical core requirements and line drawings that provide a schematic outline of the facility generated from square foot allotments for building types.

USACE's Savannah District effectively uses design standardization. For example, its typical barracks project uses a design template and repetitive designs, reducing design cost 4 to 4.5 percent. Reuse of designs for barracks at Fort Knox and Fort Campbell accounted for similar savings. Reuse is more typical when there is phased project implementation of the same type of construction.

These savings can increase when the same A-E and construction company are used during projects that are repetitive in nature. A-E liability concerns may reduce the size of cost savings when an A-E must validate another firm's design. USACE often addresses this issue by performing this work in-house, thereby eliminating the A-E liability concern. Using the same construction contractor capitalizes on lessons learned, already-purchased special equipment, identified suppliers, and special construction techniques.

Design standards are also good for programming and developing DD Form 1391. Having the standards simplifies the development of both the design and cost estimate during the planning stage. The DD Form 1391 also acts as a filter to capture any operational or technical deviation from the standard design criteria. The ACSIM and USACE must approve justification for any variation from the standard.

Ample opportunity exists for effective use of standards. USACE estimates that 60 to 70 percent of MILCON will be focused on building barracks—an ideal building type for standardized design. To support its use, USACE has implemented a Facilities Standardization Program Library, which is supported by the Huntsville Engineering Support Center. This web-based library of design

standards is available to support the use of standardized design. The Savannah District, a leader in the use of standardization, generated the majority of the projects referenced on the web-site.

Standard designs, however, limit the ability to keep up with the changing needs of the operating units. Custom fitting the standards to geographical variations and keeping them current with changing demands and policy requirements is an effort. Replicating a design from one site to another requires a review of the site characteristics and the suitability of the new site. For example, barracks designs for Fort Jackson adapted for Fort Detrick had water intrusion issues in the basement because the design had not been adjusted to suit differing site conditions.

The suitability of standardized designs depends on fitting them to customers' requirements, site conditions, and local architectural standards. Equally important is the time it takes to develop a design through the programming cycle. Over time, user needs may change and make the design obsolete—one reason, perhaps, that the Army has not embraced design standards more fully. It also might explain why a program initiative (begun in 1985) to use standardized design has lost momentum.

The 30 standards for different facility types include a warehouse, childcare centers, barracks, and sports facilities. Currently, two-thirds of the facility type standard designs are dormant. The funding for the program was substantial, but the budget has been reduced. To adapt to constantly changing requirements, installation needs, and Army policy, standards need to be continually updated and maintained if they are to be useful.

RECOMMENDATIONS

USACE annually executes a complicated design program that supports the Army's MILCON and family housing programs. Although it has provided billions of dollars of facilities for the Army, changes should be made. These changes, described in the following subsections, can increase the effectiveness and efficiency of USACE design efforts.

Planning Charrettes

Planning charrettes significantly improve the communication of user needs to the design team.[11] USACE and the installation DPWs are using planning charrettes on a limited basis to ensure they identify issues prior to full-scale design.

These meetings help identify user requirements, the facility's place in the installation's master plan, and the items needed to begin design. The information developed during these meetings is used to verify project requirements and scope. If

[11] Planning charrettes are meetings between the end-user, DPW, contracting officer, USACE, and possibly an A-E firm already under an indefinite quantity contract.

the scope and the estimate generated by the charrette differ, the 1391 is adjusted accordingly.

A few of the installations we visited during this project employ planning charrettes, which, although not widely used now, are becoming more popular. Some use a scaled-down version where the design agent meets informally with the end-user and installation representatives to refine scope requirements. Although the charrettes are recognized for the value they provide, frequently they are not used due to funding constraints.

We recommend that ACSIM and USACE encourage the use of planning charrettes and provide funding to support these efforts.

Mechanical/Electrical Center of Expertise

A mechanical/electrical center could serve as a source of expertise—providing council to designers/construction managers—and as a mechanical specification/drawing reviewer. The mechanical/electrical expert would review specifications, design drawings, submittals, and shop drawings with a focus on compliance with contract documents and the equipment's effect on life-cycle O&M costs. The cost of participation in the review process would be minimal if it could take place in a "virtual" environment, and the expense would be incidental compared with the potential benefits derived from improved equipment specification, design coordination, and life-cycle performance.

USACE, in a technical report,[12] outlines the use of virtual design review for the purpose of applying design and buildability, constructability, and operability (BCO) reviews. The research objective was to develop an integrated support environment for design and BCO reviewers. We suggest that a similar environment enhanced with the use of portal software employing the internet, could be used to facilitate and improve the review and coordination of mechanical design elements, function as a repository for best practices, and serve as a prototype for technical knowledge management.

So, to overcome some of shortcomings in the specification, procurement, and installation of mechanical equipment, we recommend that the Army consider implementing a web-based center of expertise for mechanical/electrical equipment specification and design review. This recommendation is best taken in conjunction with USACE's current knowledge management initiatives.

Flexible Design

Flexible design is a hallmark of current private-sector design practice. Buildings are designed to provide flexible space that can be used for a variety of purposes.

[12] USACE, Construction Engineering Research Laboratory, *Web-Enabled Design Review and Lessons Learned*, Technical Report 98/31, E. William East, April 1998.

At the requirements determination stage, even before conceptual design, the designer looks at how the building can be adapted for changes during its useful life. The designer considers how, with just the structural elements and building's skin in place, the interior space can be manipulated to support a variety of functions.

Both the private sector and the federal government use flexible workspace design. the General Services Administration (GSA) practices an "integrated workplace" approach that attempts to maximize worker productivity by providing a work environment that is stimulating and satisfying. Managers should view the workplace not just as overhead, but as a tool to improve work performance. Ninety percent of building life-cycle costs are made up of employee salaries and benefits, so it makes sense to provide an atmosphere that maximizes the output of that cost.[13]

The high life-cycle cost of reconfiguring workspace is the force driving flexible workspace design. Designing flexible work environments requires an alignment of design priorities that link real property managers with human resource specialists and information technologists. The intent is to provide workspace that can be easily reconfigured to suit changing requirements and ultimately reap the benefits of reduced construction costs.

Army facilities are typically designed to maximize the functionality for the intended mission. However, this approach does not reflect the reality that Army facilities often have to accommodate mission changes, such as those taking place now, throughout their usable lives. Using flexible workspace designs will help the Army meet mission, technical, and systems changes cost-effectively and minimize the impact of obsolete facilities.

We recommend USACE issue guidance that encourages the use of flexible workspace in Army designs.

Design-Build Contracts

We outline the merits of design-build above; significant benefits will be derived from using it more often. It should, in many cases, be the contracting vehicle of choice within the Army, particularly for facilities that are straightforward and repetitive in nature. This includes family housing, where it is already used for the majority of projects, and barracks and administrative buildings. These building types lend themselves to the strengths of the design-build process.

The design-build approach can help the Army improve both its design and construction processes, shortening the time required and reducing the costs. Implementing design-build on a large scale and realizing its potential benefits will require a considerable culture change for many Army organizations. USACE has recognized this issue and is currently working with industry groups to identify where and how it needs to change.

[13] Stanley C. Langfeld, *The Integrated Workplace, A Comprehensive Approach to Developing Workspace*, Reports from the 1999 International Development Research Council World Council.

The Army, through direction of the ACSIM's office, has already mandated the increased use of design-build contracts; we concur with this decision.

Design Cycle

The use of parametric design techniques has increased the accuracy of project cost estimates in the early phases of design development. They have the added advantage of shortening the design cycle since they facilitate conceptual design development. Government and private-sector organizations have used this approach with great success, but, although endorsed by the Army, it is underutilized.

We recommend that the Army use this approach, which can improve and shorten the existing design process.

Chapter 4
Construction Phase

INTRODUCTION

To accurately frame a discussion of the construction phase, we need to consider the entire life-cycle process. Although the cost of construction itself is a substantial part of the total life-cycle facility cost, the impact of the quality of construction on the facility's O&M cost also affects the total life-cycle cost. The same is true for the combined effect design has on both construction and life-cycle costs.

The construction phase comprises two major parts:

- The acquisition process, where the owner solicits and awards the construction contract to a builder
- The construction process, during which the facility is constructed and turned over to the end user.

We discuss each in turn, including the Army and private-sector acquisition and construction subprocesses and value benchmarks. We then present our findings and recommendations regarding the Army's construction processes.

ACQUISITION PROCESS

Army

As many as four organizations participate in Army construction contracting: the customer, USACE, the A-E firm (if the design was not accomplished via the USACE in-house work force), and the construction contractor. USACE acts as a facilitator and conduit between each of the other participants. The customer works with USACE on identifying and refining requirements, then USACE and the A-E work together to develop the design. Finally, USACE and the construction contractor work together managing the construction process. The channels of communication are well defined.

The Federal Acquisition Regulations (FAR) and Defense Federal Acquisition Regulations (DFAR) govern the Army's acquisition process. They identify the types of contracts that are considered appropriate for the acquisition of construction services. The FAR and DFAR also identify the typical steps and procedures that must be followed for each of the contract types.

A number of contract types are available for acquiring construction. Among these are firm-fixed-price, fixed-price-incentive-fee, fixed-price-award-fee, cost-plus-award-fee, and cost-plus-incentive-fee contracts. These contract types are used with design-bid-build or design-build strategies, and the acquisition strategy and nature of the procurement determine the type employed. The selection of the successful offeror is typically accomplished using either an information for bidders (IFB) or RFP approach.

INFORMATION FOR BIDDERS

An IFB is typically used when a firm fixed price is being sought from a qualified low bidder. Historically, it has been the preferred way for the Army to acquire construction. Unfortunately, the IFB process does not always produce the best product at the best price. When an IFB is issued, the government is fundamentally saying that it will only consider the price for any qualified bidder. No other factors are taken into account for offerors who meet the minimum qualification requirements.

The low-bid process, by nature, does not emphasize quality. Low bidders, which typically compete with many others for project award, must necessarily bid to perform the lowest acceptable level of quality. Under this type of contracting, there is little incentive to provide a higher level of quality than is specified. This may not be a problem when the optimum level of quality is well established or it is possible to readily ensure the level of quality provided. However, that is frequently not the case. Many times specifications can be interpreted in a way that permits a less-than-optimal—from a life-cycle perspective—level of quality. In addition, the best efforts of QC and quality assurance (QA) personnel can't always ensure that the minimum level of quality is being met.

REQUEST FOR PROPOSAL

The RFP process permits the consideration of factors other than price when selecting a contractor. The RFP method is synonymous with source-selection and best-value contracting. This approach is based upon the belief that if the government can contract with the best-qualified contractor for a reasonable price—not necessarily the lowest—it will get better value for its construction dollar.

RFP selection can be used with either the design-bid-build or the design-build approach. However, it is virtually a necessity when the contract is to be for design-build services. Issuing an RFP and evaluating proposals tend to be more costly and time-consuming than an IFB. The time and cost savings associated with selecting a quality construction contractor—documented in the case of design-build contracts—generally more than offset the additional cost.

Private Sector

The private sector—not regulated by the FAR, DFAR, or similar requirements—is not required to have full-and-open competition, although some large corporations do have their own procurement requirements. Typically, it is in the best interest of an owner to have as much competition as possible, but no laws mandate it. Accordingly, more than half of all private-sector projects are privately negotiated. The private sector can focus on building and nurturing long-term relationships, which have significant benefits, with both design firms and construction contractors. The cost of doing business with repeat customers is typically less as the partners establish lines of communication and learn more effective means to accomplish tasks.

The private sector contracts for larger projects through a process similar to the federal RFP contracting method. Once the need or requirement has been established and design work has been started, the company will contact the contractors they want to work on the project. These contractors then develop proposals to demonstrate why they should be awarded the project. Three types of contracting strategies are used frequently in the private sector: design-bid-build, construction management at risk (CM@R), and design-build.

The client, A-E firm, and contractor are all mutually involved in the discussions. Figures 4-1 through 4-3 show the team relationships in design-bid-build, CM@R, and design-build.

Figure 4-1. Design-Bid-Build Team Relationship

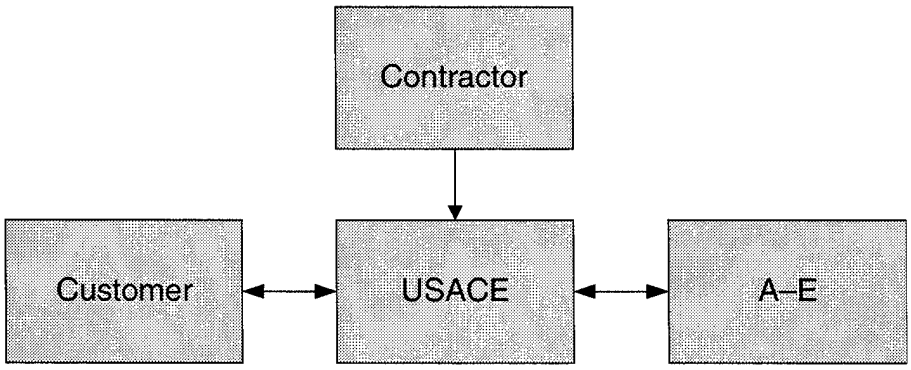


Figure 4-2. CM@R Team Relationship

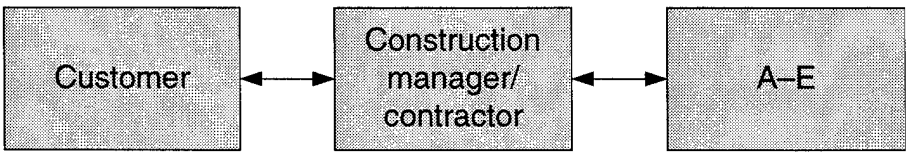
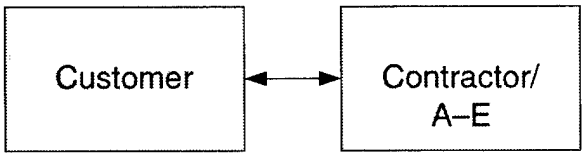


Figure 4-3. Design-Build Team Relationship



Process Comparison

Construction contractors in the private sector are involved in the construction project much earlier than those in government contracting, particularly when CM@R or design-build contracts are used. The design and construction firms are hired for preconstruction planning and conceptual development. This allows the customer, A-E, and contractor to begin refining design requirements and the conceptual design earlier in the process.

The private-sector process ensures that the contractors bring their expertise in construction to the table. Their expertise in construction means and methods, constructibility, and cost are a valued asset to the owner and by extension to the A-E firm performing the design work. The process allows the construction contractor and A-E to communicate more openly in determining what is needed and what alternatives in terms of quality and value are available.

In the Army acquisition process, unless the project is going to be a design-build contract, the construction firm is not identified during the design phase. This method of contracting tends to keep the A-E firm and the contractor removed from each other, losing any value the contractor could provide in design development.

The private sector may hire a construction management (CM) firm as a fourth entity to assume the role that the contractor fills during preconstruction activities. The CM firm acts as the client's representative, managing the construction contract award and construction process. The role is similar to that of USACE in the Army's construction process. However, in private industry, the CM firm does not separate the entities from each other. Instead, it acts for the client, while the client still has immediate access to all parties involved.

Also, in the private sector, the end user is usually the manager of the funding, seldom the case in the Army. All funding issues in the Army contracting process must go through additional layers of bureaucracy to be processed. This is true throughout the planning/design/construction process, from determining if the project cost is within the estimated budget to asking for additional funding for modifications during the project.

CONSTRUCTION PROCESS

Army

The USACE district is typically responsible for design and construction contracts, including reviewing and approving changes to the design and critical submittals. District project managers coordinate the efforts of designers and construction managers.

The resident engineer (RE) is in charge of the day-to-day supervision of the construction contract. The RE or a representative—project engineer or construction representative—is typically located near the project and, for large projects, may be located on the project site itself. The RE acts as an inspector, provides oversight for the contractor's QC program, monitors progress against schedule, and reviews and processes the contractor's monthly progress payments. The RE also performs the first review of submittals and any requests to clarify the construction documents, passing on to the district office any critical design submittals and information requests that require the district office's expertise.

Once it awards the construction contract, the Corps holds a preconstruction meeting that involves all available key stakeholders in the project. This typically includes the contractor's essential project personnel, the RE and project manager from the Corps, and any critical representatives from the customer, including the facility's end user. They review the general schedule and project scope and discuss any critical customer or contractor issues.

At the same time or shortly thereafter, the contractor submits the construction schedule, QC plan, schedule of payments, and submittal schedule. The Corps reviews these submittals and approves them or requests revisions. Concurrently, the submittal process of construction materials begins (discussed in detail below). Once the contractor submits the QC plan and schedule, and the Corps provides at least preliminary approval, the construction work begins.

QUALITY CONTROL PROGRAM

To monitor the quality of the work put in place, USACE oversees the quality control (QC) program that the contractor implements. The contractor assembles, submits to the Corps, and obtains approval for its QC team and QC plan. The contractor performs all inspections and documents the installation of the work in accordance with the contract documents. Every major work activity is divided into three phases of review and inspection: preparatory, initial, and follow-up.

Before the start of work, the Corps holds a preparatory meeting for the QC team, the general contractor, and the subcontractor responsible for the work activity. This review meeting ensures that all relevant submittals have been approved, work preceding the activity has been installed properly, and the contractor's work

plan conforms to contract requirements and the schedule. As soon as the work activity begins, an initial inspection of the work takes place and the contractor corrects any spotted deviations from the contract. As work proceeds, follow-up inspections occur to ensure the builder's work remains in compliance.

QC inspectors identify unacceptable work and document any noncompliance in a rework log. If the repair or replacement of the work is straightforward, the RE's field office provides direction. If the fix is more complicated, the RE requests that the design engineer from the district office provide an engineered solution. The contractor's QC manager documents the repairs and provides final certification that the work has been installed in accordance with the contract documents or approved design changes.

MODIFICATION PROCESS

Due to funding constraints, the modification process can be very complicated, particularly if a change order increases the contract value beyond its approved value.

The initial step in the process is determining if the change in question is truly additional work beyond the scope of the contract. If the contractor and Corps differ on their interpretation, the Corps can direct the contractor to proceed with the work, in which case the contractor submits a claim for additional work. Once a contract change is established, the Corps performs value engineering to determine if potential savings can be derived from improving the design through material substitution or design modification.

The next step in the process is to establish the source of the change. If it is an error or omission in design, responsibility must be determined. The responsible designer then provides a design modification to correct the error or fill the omission.

Next, the RE's office identifies the scope, makes a rough cost estimate, and checks the availability of funding. If funding is available, the Corps identifies and sets aside contingency funding; if not, the Corps must identify another funding source.

Once funding is designated, the RE prepares the modification with its SOW and cost estimate, then requests that the contractor prepare and submit a cost proposal. The Corps then negotiates the work and, if it agrees on scope and cost, issues a bilateral contract modification and notice to proceed. If the contractor and Corps cannot agree, the Corps issues a unilateral modification and the dispute is resolved after the contractor completes the work, either through partnering or the claims process.

Other Agencies

To compare the Army's processes with others in the public sector, we looked at two agencies, the Navy and GSA. They engage in the same phases of life-cycle facility management that the Army does, including planning, designing, constructing, operating and maintaining facilities.

The Naval Facilities Engineering Command (NAVFAC) uses construction procedures similar to the Corps. All of the major subprocesses are fundamentally the same. The only major difference is in acquisition—the Navy makes greater use of both design-build and best-value contracting.

The Army and GSA construction processes are fundamentally different. Unlike the Army, GSA does not perform its own CM, but typically hires a firm to provide these services under its oversight. Also, GSA does not maintain a significant in-house design capability, preferring instead to contract out for these services. GSA is much more of a project management organization since it contracts for all other services.

Finally, the funding structure that supports GSA construction alters the management and performance focus significantly:

- GSA does not draw from distinct pools to obtain its design/construction and O&M funding. Therefore, it can take an integrated approach to life-cycle facility management, whereas the Army considers these phases separate and distinct events. Consequently, the design attributes that affect the long-term performance and sustainability of the facility are more important in the GSA approach.

- GSA charges the various government agencies "rent" for providing the space and support services and must justify the rent by proving itself competitive with the private sector.

- To prove its competitiveness, GSA tracks several performance measures that it uses to demonstrate its success relative to private-sector benchmarks. These include the following:

  - Cost and schedule growth

  - Design, CM, and unit construction costs

  - Customer satisfaction.

The Corps also tracks these measures but not with the same sense of urgency, regularity, or consistency as GSA, which uses them to measure and drive improvement. The funding turbulence created by congressional appropriation affects the Corps' ability to provide seamless service. GSA, with greater budget

control—only about 10 percent of their total budget is appropriated—does not have the same problem.

Private Sector

Fundamental differences in motivation between the Army and the private sector create major differences in their organizational structure and their respective processes. Profit propels the private sector. The decision to undertake a given project is based on the expected rate of return on the investment. In the Army, the decision to execute a project focuses on its utility in meeting the mission. In addition, the private sector is not burdened with complying with federal government contracting requirements, which can substantially increase the cost of construction.

Process Comparison

MODIFICATION

The RE's office receives the proposal and determines its merit. If the modification has merit and is within the authority and capabilities of the RE, it is processed at the RE level. If the modification has merit, but is outside the RE's capabilities or authority and design is required, it is forwarded to the district for resolution.

The source of funding also needs to be determined. Additional funds can sometimes be drawn from a "project funds balance" pool at the district office. If it is an owner-initiated change order, the owner is responsible and Corps requests the funds directly. In contrast, the private sector typically provides a flatter, more streamlined review process.

QUALITY CONTROL

The Corps provides a high level of inspection and QC through its QC program. The program requires that the contractor provide his own approved team of inspectors, while the Corps oversees and administers the program. The Corps process is more rigorous and labor intensive than the private sector, requiring three phases of inspection that scrutinize each work element before, during, and after it is installed.

Alternatively, private-sector contractors frequently hire testing and inspection firms directly. The level of quality specified is generally equal, but inspection requirements for the private sector are not nearly as detailed or thorough. Although no data support the value added by the Corps inspection process, the quality of the final product is probably improved. It is not evident that the QC/QA program improves the quality above the level in the private sector. However, it is clear that the Corps' QC program adds time and cost to the process compared with the private sector. The contractor includes the additional cost of providing inspectors in his bid and the Corps carries the cost of managing and administrating the program.

SUBMITTAL MANAGEMENT

The Army process of submittal review and that of the private sector are similar, but three notable differences exist:

- The private sector commonly waives the requirement for information-only submittals, saving time and effort for both the contractor and the owner.
- The Corps requires submittals on supervisory plans (safety, QC, and subcontracting plans) that the private sector typically does not, adding to the contractor's management and administrative cost.
- The Corps typically requires many more submittals than does the private sector, particularly with shop and erection drawings.

PROGRESS PAYMENT

The only significant difference between their respective methods of making progress payments are the Davis-Bacon wage interviews and certified payroll certifications that the Corps is required by federal law to perform. This process adds time and cost but is mandatory for all federal work.

VALUE BENCHMARKS—ACQUISITION

Time

INFORMATION FOR BIDDERS

Several issues affect the timing of the IFB contracting process. These issues include

- the time regulations listed in the FAR and DFAR,
- the accuracy of the construction plans and specifications,
- the ability of the installation/command to get additional funding, if necessary, and
- the manpower available in the contracting office in relation to the current backlog of contracts.

For construction projects over $500,000, the FAR and DFAR dictate that invitations for contract bids be publicized for at least 30 days in the *Commerce Business Daily*. The invitations are also publicized locally as well as in trade magazines. This advertisement is designed to generate as much interest and competition as possible, which ideally translates into more bidders, greater competition, and, ultimately, a lower price for the contract. For construction projects under $500,000,

the local contracting officer sets the time and location of notification requirements.

The accuracy and detail of the developed construction plans and specifications also affect the time involved in letting an IFB contract. When interested bidders review the plans and specifications, if they find them inaccurate, illegible, or incomplete, they generate requests for clarification on all issues or details in question. This initiates the issuance of addenda, which document the clarifications and any changes to the plans and specifications.

The length of time for collecting, forwarding, and distributing the questions and answers is short compared with the time needed for the A-E firm to review and respond to each question. Having all questions and answers routed through the contracting office for tracking purposes further slows the process. A third issue that affects the time for letting an IFB contract relates to the RFP process—obtaining additional funding when the lowest bid is above the government's estimate. This issue affects the contracting office, the customer installation/command, and the MACOM.

The first two issues affect the beginning of the IFB process. The third, if realized, affects the end of the IFB process. The two areas affected are graphically depicted in the IFB flowchart in Appendix A.

The last issue affecting the time of an IFB contract is the manpower available in the contracting office. The time is spent on the paperwork required in tracking the contract from plans and specifications, interested bidders list, evaluation of bids, evaluation of prospective winning contractor for financial soundness, and the establishment of a payment process from the accounting office, through the contracting office, to the contractor.

REQUEST FOR PROPOSALS

The same four issues that affect the timing of the IFB affect the RFP process. The following requirements drive the additional time consumed during the RFP process:

- Creating the proposal evaluation criteria
- Evaluating the technical proposal (with a qualified review team)
- Creating the proposal package
- Presenting the proposal

- Preparing for and negotiating with the qualified contractors
- Reviewing the contractor's best-and-final offers.

When using the RFP contracting method, the contracting office, in conjunction with the customer installation/command, must set the criteria to be used in evaluating each proposal before the RFP is released. Some of these criteria are similar for many contracts but can be very detailed and specific to the type of project being contracted.

The review of the technical proposals can be a time-consuming process. The evaluation team must establish that the contractor's proposal meets all the criteria identified in the RFP. The review also establishes a ranking of the most qualified contractors for the project, independent of price. The review team should consist of personnel formally trained to sit on a technical evaluation board. The Defense Acquisition University (DAU) offers classes for all federal agencies for this training. On larger or more technical projects, the contractors may be required to give an oral presentation of their proposal. This process can be lengthy when numerous contractors are vying for the project.

Once the technically qualified proposals have been identified, the contractors are asked to provide their best-and-final offers. Although these offers are usually made quickly, it adds time to the process.

Cost

The two cost drivers in the IFB process are the manpower used and the cost of duplication and distribution of plans and specifications. Questions from the interested bidders about the plans and specifications directly affect both. Although the cost of manpower used is a sunk cost, the movement toward electronic communication of plans and specifications should reduce the time and cost of distribution (and redistribution). In fact, the majority of USACE districts have started posting plans and specifications for upcoming MILCON work on websites for contractor review.

The two cost drivers in the RFP process are the same. Manpower raises the cost of the RFP contracting method for two reasons:

- It simply takes longer to get through the full process because it is more complex.
- Because the technical review board must be a separate entity from the price review board, more people are involved.

Quality

In using the IFB process, public agencies tend to configure their projects to spend available funds instead of meeting long-term needs. From a comprehensive capital asset standpoint, this approach can have disastrous consequences. The design-bid-build process focuses on the initial costs to the exclusion of maintenance and operational costs. In this sense, design-bid-build drives competition to provide only a part of the true scope that a facility requires. By concentrating solely on construction, the design-bid-build contract excludes other critical considerations, including the costs of designing, maintaining, and operating facilities over an extended period.

Unfortunately, public agencies have limited budgets and are under constant political pressure to produce short-term results. In the Army's case, this effect is more pronounced because of the high turnover among installation leadership. High turnover increases the pressure to demonstrate short-term improvements. As a result of the bias toward lowest cost and short-term results, quality suffers. A partial solution is to use a different contracting vehicle. As discussed in the design chapter, design-build reorients the focus, placing a higher value and importance on quality.

VALUE BENCHMARKS—CONSTRUCTION

Time

The difference in time of performance between Army construction and the private sector is not substantial. Various federal contracting requirements and QC programs increase the effort for Army construction, but any marginal impact on schedule has not been quantified. Indeed, some research indicates that government projects do not perform significantly better or worse than private-sector projects in terms of time.[1]

Cost

CM COSTS

LMI recently performed a survey, sponsored by Construction Management Association of America (CMAA), comparing the Army's cost for CM to the private sector. The survey's results indicate that the fees charged by USACE compare favorably with private-sector CM fees. Although the fixed fee USACE charges is generally higher than the private sector, the services USACE provides are typically more complete. The study, which compared the service levels between the two, showed that USACE performs almost 100 percent of the

[1] Derek H.T. Walker, "An Investigation into Construction Time Performance," *Construction Management and Economics*, 1995.

CMAA-listed functions, whereas the private sector typically performs 80 percent.[2] Appendix E contains a more complete discussion of the LMI/CMAA survey and its results.

USACE CM fees also compare favorably with other public agencies. The fixed 5.7 percent fee USACE charges for military CM contracts is slightly greater than that charged by GSA, which ranges from 4.5 to 5.8 percent.[3] But again, one must consider the additional services provided by USACE, which offset the difference.

The Department of Energy (DOE) rate is typically higher. The CM costs for individual projects vary widely as does the type of projects DOE manages. It is not unusual for DOE to handle projects in excess of $250 million. On a project similar in scale to a typical MILCON project programmed for $11 million in total project costs, the CM portion was 7.0 percent.

However, the flat rate USACE uses tends to undercharge clients on small projects and overcharge them on large ones. By comparison, in the private sector it is common practice to use a management fee proportionate to the total construction cost. The fee is high for lower cost projects and correspondingly lower for projects that cost more. Charging flat rates for MILCON projects makes sense for several reasons:

- USACE is providing a service to one customer, the Army, and savings received on larger ones balance any disproportionate management fees incurred on smaller projects.
- It has advantages from a programming perspective in that accurate budgets can be derived to precisely match supervisory and administrative expenditures. This simplifies the estimating process for planning, budgeting, and programming.
- The amount of administration required to capture total management costs is minimized.

CONSTRUCTION COSTS

LMI reviewed the actual construction costs of MILCON projects and compared them with private-sector costs. However, to make an appropriate comparison, we adjusted the Army costs to account for the cost of complying with federally mandated regulations not required in the private sector.

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[2] Logistics Management Institute, *U.S. Army Corps of Engineers Military Construction Management Costs*, Report CE309R1, Jordan Cassell and Jeffrey Hawkins, May 1994.

[3] Logistics Management Institute, *Performance Measurement and Improvement at the Public Buildings Service,* Report GS603R1, Karen M. Dahut, Tabula W. Bost, Marguerite M. Morrell, John R. Selman, and Robert P. Silverman, February 1998.

LMI, in conjunction with the American Consulting Engineers Council (ACEC), conducted a survey to quantify the extent of the burden.[4] In the last 4 years, the burden has diminished considerably, from 16 to 9 percent. Several possible explanations for this decline include the following:

- Commercial and DoD specifications have converged.
- Wages—private sector and Davis-Bacon—have converged.
- The reduced costs of acquisition under streamlined" procedures has reduced contract clauses, and as a result, the cost of contracting with the federal government.
- Several initiatives, such as performance-based contracting, permit buying "better, faster, cheaper."

After adjusting the MILCON costs for the additional cost caused by compliance with federal contracting requirements, the normalized cost for tri-service construction for family housing compares favorably with the private sector. The average national tri-service cost is less than the R.S. Means cost for the average quality, 1,400-square-foot, single-story house that is used as a proxy for private-sector construction.

Some of the cost difference might stem from economies of scale provided in tri-service projects, which are typically large. Another factor that comes into play is design-build contracts, which now predominate in family housing projects for the military. While the exact cost benefit of design-build contracting is not easily quantified, the reduced cost is a compelling feature that points to the potential benefits of using design-build for other facility types. This is particularly evident when family housing total project costs are compared with the costs of other facility types.

The comparative cost of barracks is less favorable. Tri-service costs exceed both F.W. Dodge and R.S. Means costs by 17 and 16 percent, respectively. Some of the difference between the tri-service and R.S. Means costs can be attributed to the inclusion of site costs in the tri-service number and its exclusion by R.S Means. Another consideration is the 1+1 barracks design that all military construction (excluding the Marine Corps) now adheres to. The 1+1 design is more expensive then the Means standard because it requires more bathrooms per square foot.

Tri-service administrative buildings are the most expensive facility types compared with private-sector costs. Again, the discrepancy is partly due to tri-service costs' including site work, whereas R.S. Means excludes it. This may account for

[4] Logistics Management Institute, *Impact of Federal Government Contracting Requirements on Design and Construction Costs*, Report NA610RD1, Jordan W. Cassell, Robert D. Campbell, and Paul Jung, October 1996.

as much as 50 percent of the difference between the two if the average cost of site work is 8 percent. Appendix F contains a detailed discussion of this comparative analysis.

Anecdotal evidence (drawn from discussions with private-sector contractors with government contracting experience) reveals additional explanations for the cost differences. Top management at several construction firms noted that there was an additional premium attached to bidding government work beyond the cost of complying with contracting requirements. Between Army programs that carefully monitor safety and quality, government contracting requirements, and the additional administrative burden of complying with tighter submittal standards, some subcontractors do not have the capacity, in terms of skilled employees, to deal with the increased workload. Some subcontractors decide that the work required to comply is not worth the training effort and those that do bid work build a premium into their price to cover their added costs. Many general contractors find it difficult to find subcontractors to bid Army work due to these effects. In one case, a Midwest general contractor went as far as the West Coast to find a mechanical contractor willing to bid a specific project.

The impact on construction costs can be substantial but depends on the strength of the construction market. When demand for construction is high, subcontractors can afford to place higher premiums on the cost of doing Army projects. When demand subsides, competition drives the premium down, reducing its effect.

Quality

There is a perception that the Army specifies higher quality products and designs for higher building performance to construct facilities that have a longer life. To verify this, we reviewed the USACE specification guidance and compared it with the MASTERSPEC library commonly used by the private sector to derive project specifications. Our analysis of specific sections of comparable specifications indicates that the Army excludes some of the lowest levels of quality specified in the MASTERSPEC for some product types. This eliminates some low-end quality building materials from their specifications.

Precisely translating this difference into dollar terms is impossible without performing a detailed case-by-case analysis of both Army and private-sector project specifications that is beyond the scope of this study. In general terms, the Army does not have low-end quality equivalents to the private sector for speculative office buildings and multifamily housing. However, at the other end of the spectrum, the Army does not have an equivalent to the high-end quality that the private sector builds to suit clients that desire and can afford best-in-class office or residential space.

The Army does not appear to "overspecify" material, equipment, and workmanship. Although it tends to generate tight and rigid specifications, the added cost of compliance is mostly an administrative one. It involves added effort on the part of

contractor to provide submittal data that complies with the letter of the specification. Aside from this and the government restriction on the use of proprietary specifications, no other significant difference is apparent.

FINDINGS

Acquisition

Installation and design/construction managers have mixed positions on increasing the use of design-build contracts. Most of the negative attitudes appear to stem from a lack of understanding and expertise in managing a relatively new contracting process. Their argument that design-build limits control over scope and the design process is not entirely justified. Client requirements and the design can be effectively identified in advance of contract award by working carefully with the client and A-Es to clarify end-user needs. Participation in and review of the design as it progresses after award can be written into the contract to ensure the client has greater control over the end product.

Managers also complained about the additional manpower design-build requires during the RFP process; however, contracting offices untutored in the process can achieve effectiveness and efficiency with experience. Installations that had more experience expressed confidence in their ability to manage it and appreciated the benefits derived from its use. The same applies to best-value contracting, although overall there was less resistance to its greater adoption. Several installation mangers were enthusiastic about the prospect of using both best-value and design-build contracts more frequently, and there is ample evidence to support their increased use. The Project Delivery Institute has studied the impact of using design-build to improve quality. Figure 4-4 depicts the measure of improvement in quality that design-build can provide.[5]

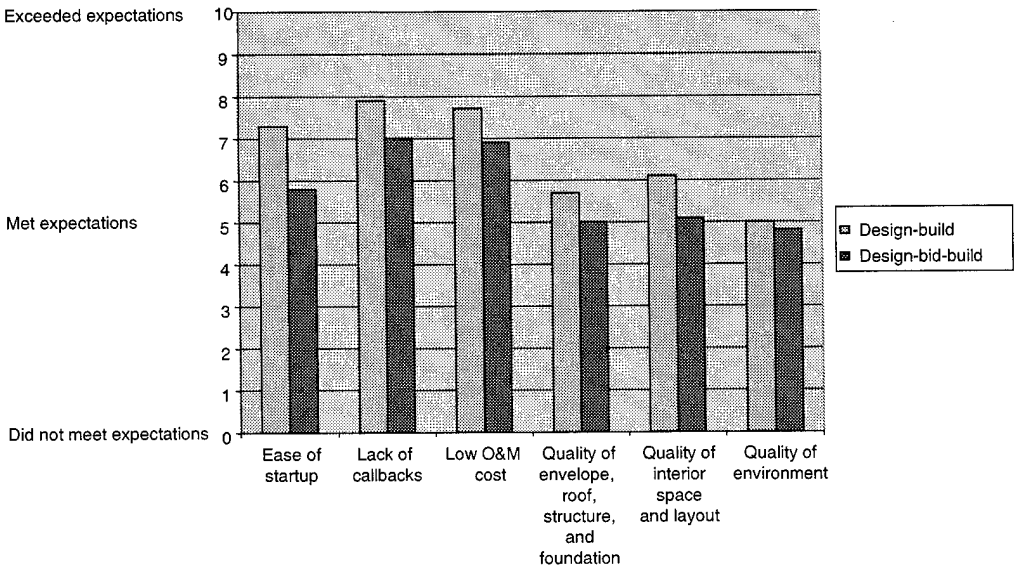
Construction

Our findings are grouped into four topics: cost drivers for construction, cost constraints and their effects on quality, construction quality and its impact on O&M costs, and project delivery types.

The Army is perceived to have some higher design requirement standards than those typical of the private sector. (For example, the Army uses heavier foundations, concrete block in corridors, and vinyl-covered gypsum board in private rooms.) This perception is supported somewhat by our comparison of MASTERSPEC with DoD guideline specifications.

[5] See Note 9, Chapter 3.

Figure 4-4. Design-Build and Design-Bid-Build Comparison



In contrast, we heard numerous complaints about the HVAC systems, which frequently are of lower quality than those in the private sector. Several factors, all having to do with cost, contribute:[6]

- Pressure to keep within the program amount forces the selection of lower quality. There is a constant battle between cost and specifications—when cost is an issue, quality suffers. Installations will sacrifice quality in some areas to keep within the 1391 program amount. Often, inferior equipment is selected to save on costs.

- The lack of contingency funding (recently eliminated) increases the pressure to hold down costs. Having no allowance for contract changes forces decisions that affect the quality of the end product. For example, a specified HVAC system was downgraded to reduce costs.

- Poor location for serviceability was selected to save money on space due to cost considerations.

These decisions ultimately drive up the life-cycle cost because of the implications on O&M and recapitalization.

Also, tri-service cost factors do not adjust for market conditions—when demand is high, cost is at a premium. Nevertheless, market adjustments are not permitted as a consideration in cost estimates, which also affects quality.

[6] Installation managers say that procurement rules prevented the specification of higher quality equipment, but, in practice, we found no firm basis to support their reasoning. Although regulations prevent proprietary equipment from being specified, there is no barrier preventing specifications from prescribing higher quality.

Several sites showed that design, construction quality, and an effective O&M program are directly connected to a building's performance, recapitalization rate, and total life-cycle cost. Ample anecdotal evidence showed that the lack of preventive maintenance (PM) caused shorter mechanical equipment life spans. For example, we heard about roofs being replaced before the end of their design lives due to lack of maintenance. We explore this issue in detail in the chapter on O&M.

Finally, at several installations the consensus was that the traditional delivery method lowers life-cycle value. Success in the public arena is measured by receiving goods and services at the lowest possible initial cost. This is driven by what is easiest to measure—the up-front costs of design and construction. However, this approach discounts the importance of maintaining and operating facilities over time. When magnified by the pressure to produce short-term results, considerations to design and build for the facility's full life cycle become secondary.

RECOMMENDATIONS

Acquisition

Efforts to decrease cost and time in the construction acquisition process will only produce marginal results. Improvements in acquisition should focus on building performance over the life cycle. If the acquisition team can create a contract that provides the government with the best-value project, time and money will be saved over the life cycle of the facility.

Two methods that the Army has started to use to improve the output of the planning, design, and construction have direct, positive impact on the facility's life cycle: planning charrettes and greater use of design-build contracts. We discuss the first in Chapter 3 and the second in the paragraphs that follow.

Although the Army uses design-build contracts for their family housing projects, the ratio of contracts performed using this method for other facility types is much higher both in the private sector and in the other military branches. The Air Force performs about half of their projects under design-build, and the Navy expects to perform over 40 percent using design-build in 2001. As noted in the previous chapter on design, USACE leadership and ACSIM have encouraged increased use of design-build contracting. USACE has a current initiative to increase the use of design-build contracts to a minimum of 25 percent of the total construction program amount for FY02.[7]

The potential positive impacts of the design-build approach on construction are large. The CII has documented a 6 percent cost savings per square foot compared

[7] Department of the Army, Memorandum, Subject: *Utilization of Design-Build Procurement Strategy*, July 14, 2000.

with design-bid-build and a reduction in cost growth of 2.5 percent. Additionally, design-build projects tend to be completed about 7 percent faster than design-bid-build projects.[8] We recommend that USACE aggressively pursue the use of the design-build approach by accelerating its implementation time line. The potential benefits of design-build warrant an FY01 goal of acquiring 20 percent of MILCON projects via design-build, with a FY02 goal of 40 percent.

Construction

Financial Management and Cost Accountability

Although USACE collects project cost data for its civil works projects, it does not collect comprehensive cost data for MILCON projects. Data at the project level are critical in enabling greater financial management and cost accountability. Without them, diagnosing problems and establishing performance measures to monitor and control costs is difficult. An earlier LMI study suggested that the Army adopt a method of costing that permits the discrimination and recording of project costs for this purpose.[9]

The private sector uses costing information as its primary means of estimating, performance measurement, and fiscal control. Recognizing the need, USACE is testing an activity-based costing system that may be fully adopted if it shows adequate results. We recommend that they pursue this course and fully support their efforts.

Measuring and Monitoring Customer Satisfaction

USACE has a well-developed survey instrument that has been in use for a number of years for measuring customer satisfaction on completed MILCON facilities. Although USACE districts perform some customer satisfaction surveys, headquarters does not demand their use regularly or globally. The alignment of practices and their associated outcomes and the strategic vision—to "revolutionize effectiveness" through improving performance and customer satisfaction—and tactical implementation could be more readily monitored if a robust survey database existed. Therefore, we recommend that ACSIM make the completion of customer satisfaction surveys for completed projects mandatory.

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[8] Pennsylvania State University, Victor E. Sanvido and Mark D. Konchar, *Project Delivery Systems: CM at Risk, Design-Build, Design-Bid-Build*, Construction Industry Institute Research Report 133-11, April 1998.

[9] Logistics Management Institute, *Improving U.S. Army Corps of Engineers Construction Management Business Processes*, Report CE810R1, William B. Moore, James L. Hathaway, and John L. Dettbarn Jr., January 2000.

Chapter 5
Operations and Maintenance Phase

INTRODUCTION

All types of Army facilities perform O&M to ensure that they can meet their assigned missions for the duration of their planned life span. O&M work is performed on utilities, structure, interior, exterior, and all mechanical systems within the facility.

This chapter addresses the maintenance portion of O&M, specifically, maintenance and repair (M&R).[1] M&R work within an Army facility includes the following:

- HVAC system maintenance (filters, ductwork, registers, controls)
- Utility line maintenance (sewer, water, electric, gas)
- Interior structure (walls, doors, cabinets)
- Exterior structure (walls, sidewalks, roof, gutters)
- Interior cleaning (floors, carpets, windows)
- Grounds (lawns, trees, parking areas).

M&R consists of preventive and corrective work. Rehabilitation of facilities or spaces is also included in the M&R arena.

Preventive maintenance (PM), the most important aspect of maintaining a facility, is the cornerstone of M&R. If PM is not done, corrective and repair maintenance will be necessary for continued operation of the facility and its systems. If the corrective and repair maintenance is not performed, complete repair, rehabilitation, or replacement will be required. Thus, the more time and effort spent on PM, the less time and money needed for corrective and repair work within a facility. Also, PM can be planned and scheduled; breakdowns cannot.

M&R PROCESS

This section summarizes the process that the Army's DPW uses to accomplish M&R work.

[1] We address the operational or utilities costs only when impacted by maintenance or lack of maintenance.

Work Generation

Work enters the DPW office via numerous avenues. Internally, work can be generated by

- DPW staff,
- DPW inspections,
- PM programs, and
- automated engineering management systems.

External channels of work into the DPW include

- DPW customers (facility tenants/occupants),
- command decisions, and
- environmental compliance agencies.

Work Reception/Tracking

Personnel at DPW enter incoming work into the Integrated Facilities System–Mini/Micro (IFS-M) Customer Service Module. This software program is designed to track all work—incoming through completed. Pertinent data stored with each ticket include facility number, location within the facility, and point of contact at the facility.

Each job is also coded with information that identifies the entity to be charged for the work, how it is to be charged, priority level, and status. This coding allows the tenant or occupant to track the work from inception through completion and calculate its charges once the work is complete.

At completion, DPW personnel close out each job, record who worked on it, and calculate how much time was spent.

Types of Work

The Army's three general work types—PM, work requests, and service orders—fall into two categories: scheduled and unscheduled. Preventive maintenance and work requests are scheduled maintenance. Service orders can be either scheduled or unscheduled; typically, they are unscheduled.

PREVENTIVE MAINTENANCE

PM is done on all installed equipment (i.e., mechanical, HVAC, electrical) within a facility. This type of equipment requires general maintenance to keep it in

proper operating condition. This work usually encompasses replacement of filters, lubrication of bearings or shafts, and exercising of electrical contacts. PM work is generated within the DPW on the basis of the equipment manufacturer's recommendation for continuous operation. The DPW's maintenance staff is responsible for performing PM.

Without PM, equipment will not perform according to specifications, nor will it last as long as anticipated. Although not performing PM can save money, it will be lost in excessive repair work and eventual premature replacement.

WORK REQUESTS

Work requests are generally non-urgent minor repairs or improvements that can be scheduled. Scheduling is often required because this type of work may necessitate ordering materials. Tenants or occupants of the facilities generate work requests.

The occupants determine the level of urgency of their work requests. As a work request falls down the priority list, uncompleted minor repairs may turn into more urgent repairs.

SERVICE ORDERS

Service orders, known as "trouble tickets," are usually performed as corrective maintenance. Tenants or occupants typically call service orders into a service desk within the DPW in order to report problems within a facility that need to be repaired with some urgency.

The service desk determines the urgency of the service order and distributes it to the appropriate maintenance shop for action. This type of work includes clogged toilets, faulty electrical outlets, etc. Generally, the work must be completed quickly before further damage is done.

Work Performance

The DPW's in-house work force or contract personnel perform the different types of work. Some installations contract out specific maintenance areas, while others retain in-house workers for the work. All installations have some type of in-house work force.

IN-HOUSE WORK FORCE

The DPW work force typically consists of electricians, carpenters, and HVAC mechanics. A welder or a sheet-metal mechanic may be on staff as well. These workers are generally journeymen licensed in their respective fields.

The average age of the in-house workers at the seven locations we visited was in the 50s. In most cases, the workers had been at the same installation for their entire career and had extensive knowledge of the installation and all of its systems.

Contract Work Force

Many DPWs now have contracts for M&R work. These contracts vary from grounds maintenance to HVAC M&R. Work can either be assigned an immediate task number against an existing contract or rolled into a larger scope of work to be awarded within the framework of the contract.

The type of work and the performance requirement specified in the contract dictate the contract work force. Generally, it mimics the in-house work force that previously completed the work.

Facility-Specific M&R

This subsection describes M&R for family housing facilities, administrative buildings, and barracks.

Family Housing

Contracting out family housing maintenance is common among the military services. At the installations we visited, all family housing maintenance was through contracts, most of which had been in place 5 to 10 years. These contracts were for all maintenance within the units and the surrounding grounds. This combination makes the family housing contracts different in that the contractors are not trade specific. Although uncommon, each contractor may hire trade-specific subcontractors.

Service orders and PM for family housing do not go through the DPW, but directly to the contractor, which tracks the work from inception through completion. Larger work requests must go through the housing office. Typically, work requests are sent to the DPW to be done by the in-house work force or contracted out.

Administrative Buildings

Most calls for M&R work within administrative facilities go directly to the DPW. In some cases, the work is funneled through building managers for tracking. The DPW's work force performs the work in most administrative buildings unless a contractor has been hired to do work on specific systems.

Barracks

The company commanders and their respective first sergeants are assigned as building managers. All service orders and work requests from the barracks go to

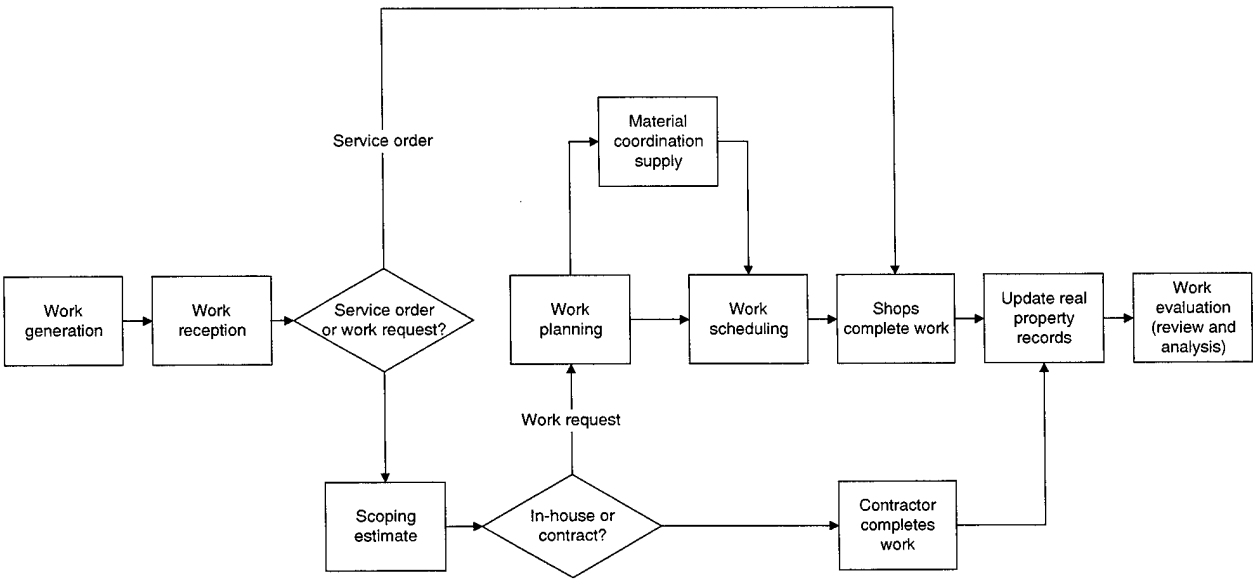
the DPW via the company commander or first sergeant so that the DPW does not receive numerous calls for the same problem within the barracks.

In-house work forces do most of the M&R work in barracks unless a specific system contract is in place (e.g., HVAC). In some cases, a repair-and-utilities team assigned to the barracks performs minor repairs and PM within its company's spaces.

M&R Process Map

Figure 5-1 is a flowchart of the basic M&R process. Figure A-5 is a more detailed flowchart for the M&R process.

Figure 5-1. Process Chart



VALUE BENCHMARKS

This section describes how the three value benchmarks we identified relate to and impact the O&M phase of Army facilities.

Cost

For FY01, the Army budgeted $1.7 billion for maintenance of real property. The cost of the O&M phase of a facility's life cycle is by far the largest cost associated with the facility, roughly 2.5 times the cost of construction (Figure 1-2). The total cost for M&R includes personnel (labor and training expenses), materials, equipment, tracking systems, and tools.

The O&M phase of a facility's life span has many cost drivers, which we discuss in the subsections that follow. These drivers are the same for the private sector and public entities, but they differ in how they deal with them.[2]

Design of Structure and Equipment

As shown in Figure 1-2, the cost of O&M far outweighs the cost of designing a facility. If time and effort is spent in the design phase to make the facility and all of its operating systems maintenance-friendly (e.g., easily accessible, containing common products), the cost of doing preventive, routine, and repair maintenance will be lower during the facility's life span.

Facility Condition

The better the condition of the facility is, both structure and equipment, the lower the maintenance costs. The performance or nonperformance of preventive and corrective maintenance affects the condition of the facility.

If quality material, equipment, and techniques are used during construction, the initial cost of maintenance is minimal for a new facility. However, if poor quality material is used or low-end equipment is installed, extensive maintenance can be required soon after completion.

If funds are spent to perform PM and recapitalization during the life span of a facility, the overall maintenance costs will be reduced. However, if PM and recapitalization are not performed, the cost of O&M on a facility will continue to grow annually.

Amount of Space

The amount of facility space is the largest cost driver for O&M—the more space maintained the higher the cost. This is true in both the private and public sector.

Human Skills

The quality of the M&R of facilities depends on the ability of the personnel performing and managing the work. Internal forces as well as the customer judge this quality. From the day-to-day work to the customer interaction, the DPW's personnel (and contractors) must be fully qualified and capable of completing the tasks assigned.

New federal facilities feature more energy-efficient HVAC systems. As the facilities become more technologically advanced, maintenance personnel must be trained on the new systems. If the DPW personnel can't perform the PM and rou-

[2] The "Findings and Analysis" section of this chapter discusses cost drivers and how the Army's process for handling them is similar—or different—from the private sector's.

tine maintenance on these systems, the anticipated savings of energy (and dollars) will be lost.

As federal employees rise through the ranks as maintenance personnel, their supervisory roles increase. Because of the shrinking federal work force, supervisors must get the most out of their employees. To do more with less, supervisors and managers must be trained to motivate personnel, as well as track and improve the productivity of their work force.

MANAGEMENT TECHNIQUES

Tracking performance measures (or metrics) is a good way to improve productivity within a service organization. Management can track both goods and services provided as well as the time and cost of performance. Tracking this kind of data can help managers compare their organization with other service providers to measure their competitiveness. In a time of numerous A-76 studies, it is in the Army's best interest to be as competitive as possible with the private sector. Performance measures include the following:

- *Tracking costs.* The private sector continuously tracks M&R costs for each facility and for individual systems within a facility. This monitoring enables them to identify trends and excesses compared with industry standards. The analysis of these data shows facility managers whether a system or facility is becoming too expensive to operate. If the analysis shows the system or facility to be more expensive than industry standards, the facility manager may decide to repair, replace, or dispose of the system or facility.

  The Army has implemented IFS-M to input data such as M&R costs for each facility, but this information is not being entered in the Army's system consistently. If these data were available, Army facility managers could track and analyze the M&R costs associated with each system and facility. This tracking and analysis is labor-intensive and therefore costly, but the expenditures are small compared with maintaining a failing system or deteriorating facility beyond its useful life.

  The Building Owners and Managers Association (BOMA), the International Facility Management Association (IFMA), and the Institute of Real Estate Managers (IREM) track these industry numbers and publish them annually. Historically, the Army kept these data and published them annually in the Redbook, but it is now no longer publishing this information.

  The "Findings and Analysis" section of this chapter compares M&R costs for the private sector with those of the Army.[3]

[3] Appendix G contains charts that show the Army's expenditures for M&R at the seven sites compared with the industry figures tracked by BOMA and IREM.

- *Tracking time*. Time, an issue when tracking worker productivity, affects a few areas of the O&M phase. Available resources, skills training, and morale can affect how long a worker takes to complete a task.

- *Tracking work*. As different types of maintenance activities are performed on a facility, the total cost, or net present value, of the facility increases. When this work is tracked for the life of the building, it is possible to identify the point at which the continuing M&R costs of a facility are no longer supportable.

END-OF-YEAR ISSUES

End-of-year issues revolve around end-of-year funding becoming available in a very short time. When this happens, many projects are awarded as quickly as possible to obligate the money before it expires. Without proper planning and appropriate time, this rapid response ties up many of the DPW maintenance personnel.

PURCHASE APPROVAL AUTHORITY

Credit card purchases are essential, especially as the Army moves towards "just-in-time" inventories, in making parts and supply purchases for repair type maintenance. Use of the credit card for material and supply purchases has greatly increased time efficiency. However, if too many levels of approval are required, this efficiency is lost.

Quality

Quality as a benchmark is affected in two major ways in the O&M phase of a facilities lifecycle: competency and attitude of the worker.

COMPETENCY

As mechanical and electrical systems are upgraded, the personnel assigned to maintain these systems must be trained. The current hiring rate and the lack of funding affect training. If new personnel are not hired with these new skills, then funds must be made available to train existing personnel on the new systems.

ATTITUDE

The attitude of the worker directly affects the quality of maintenance work. As the Army continues its progress through the A-76 studies, many maintenance workers believe they are individually targeted for removal. These feelings affect motivation and thus performance.

The attitude of the workers also affects the occupants or customers waiting for the work to be done. If the customer perceives a bad, or non-caring, attitude from the maintenance worker, the perceived quality of work performed will diminish.

User Satisfaction

We received "mildly positive" responses from the focus group surveys and comments in the following areas:[4]

- Performance
- Features
- Reliability
- Conformance
- Durability
- Serviceability
- Aesthetics
- Other perceptions.

Four of the areas listed—performance, reliability, durability, and serviceability—are directly tied to M&R. The general response from an M&R view is that the facilities are safe and usable and generally meet the required mission, but certain aspects of the facilities continuously cause problems.

Although the users had "mildly positive" responses, some negative comments clearly indicated M&R issues. The negative comments mostly pertained to the HVAC, electrical, and plumbing systems. These comments ranged from "A/C and heat go out two to three times a week" to "HVAC problems, power failures." Declining O&M funding levels, which affect training and procurement of parts or materials, directly affect HVAC, electrical, and plumbing systems.

FINDINGS AND ANALYSIS

M&R Funding

The Army has consistently restricted M&R funding. The M&R funding levels were from 40 percent to 65 percent below the requirements of the installations we visited. This cut in funding occurs year after year, and the lack of M&R is starting to show. The Army's projection of only funding 69 percent of the FY01 maintenance requirement will continue this downward trend. At the MACOM and installation levels, portions of funding earmarked for real property maintenance (RPM) are routinely siphoned off for purposes other than RPM.

[4] See Appendix C for a review of the study's user satisfaction survey.

Figures 5-2 and 5-3 show the Army's expenditures compared with the private sector's, over the period of 1988 to 1996, for family housing and administrative buildings and barracks, respectively. The charts in Appendix G show the comparison of M&R costs for each installation visited and the private sector.

Figure 5-2. Family Housing Cost Comparison

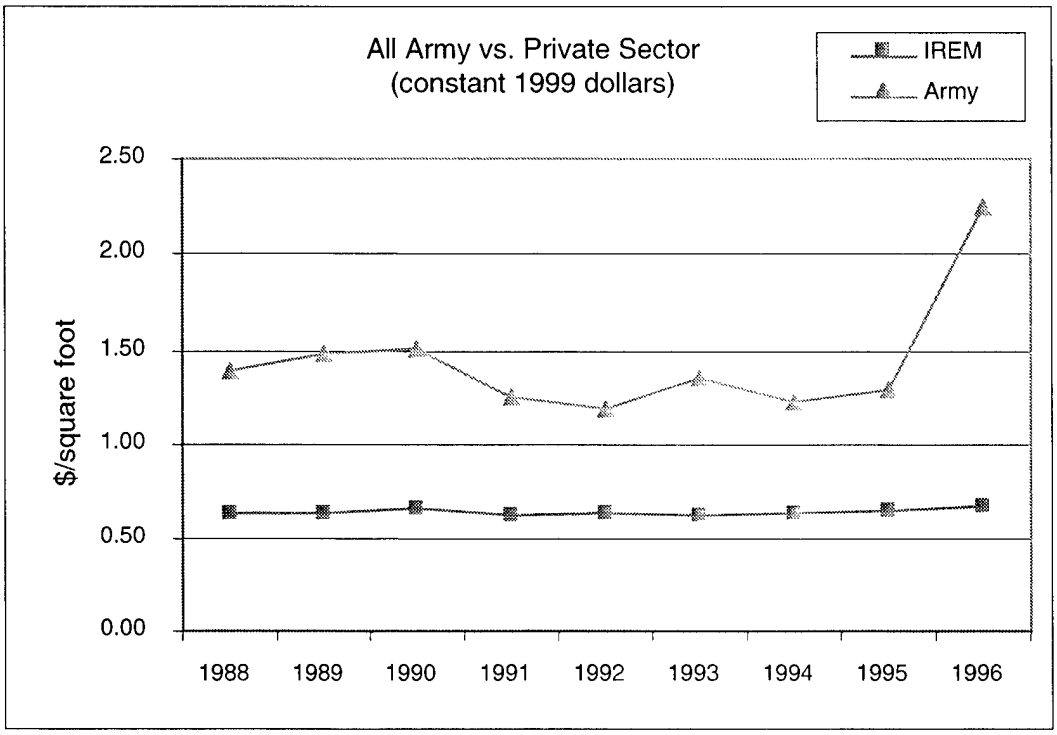
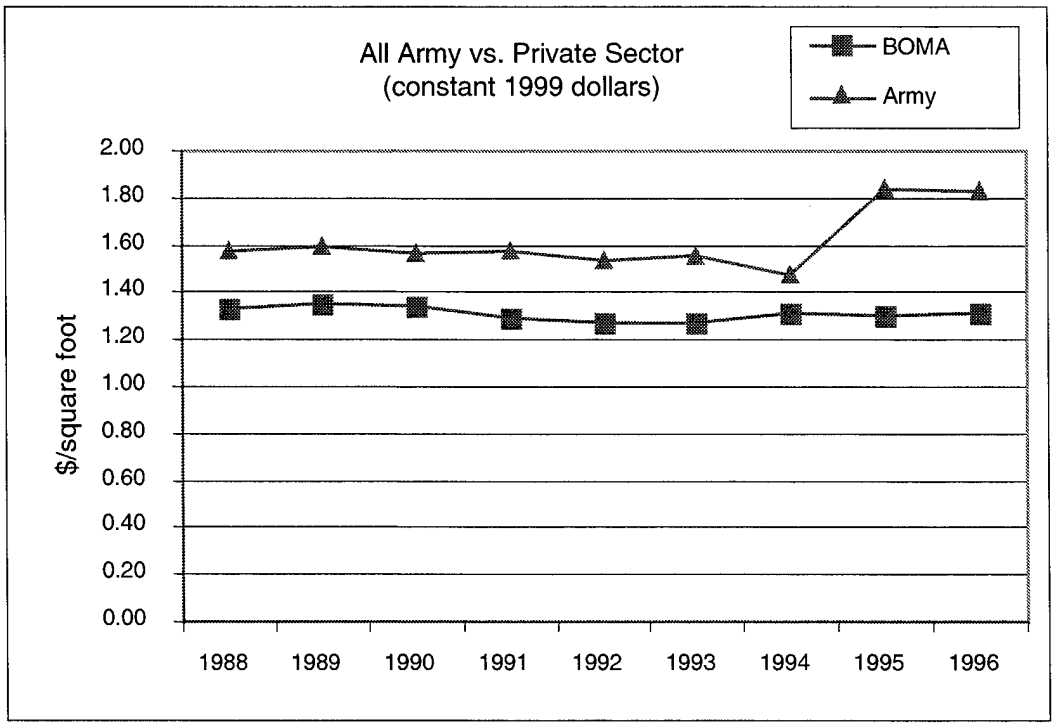


Figure 5-3. Administrative Buildings and Barracks Cost Comparison



When one considers the cost of rehabilitating the Army's facilities, the difference in spending is even more pronounced. Figures 5-4 and 5-5 quantify the difference between Army M&R and rehabilitation spending and the private sector's.

Figure 5-4. Net Present Value Cost Comparison—Housing

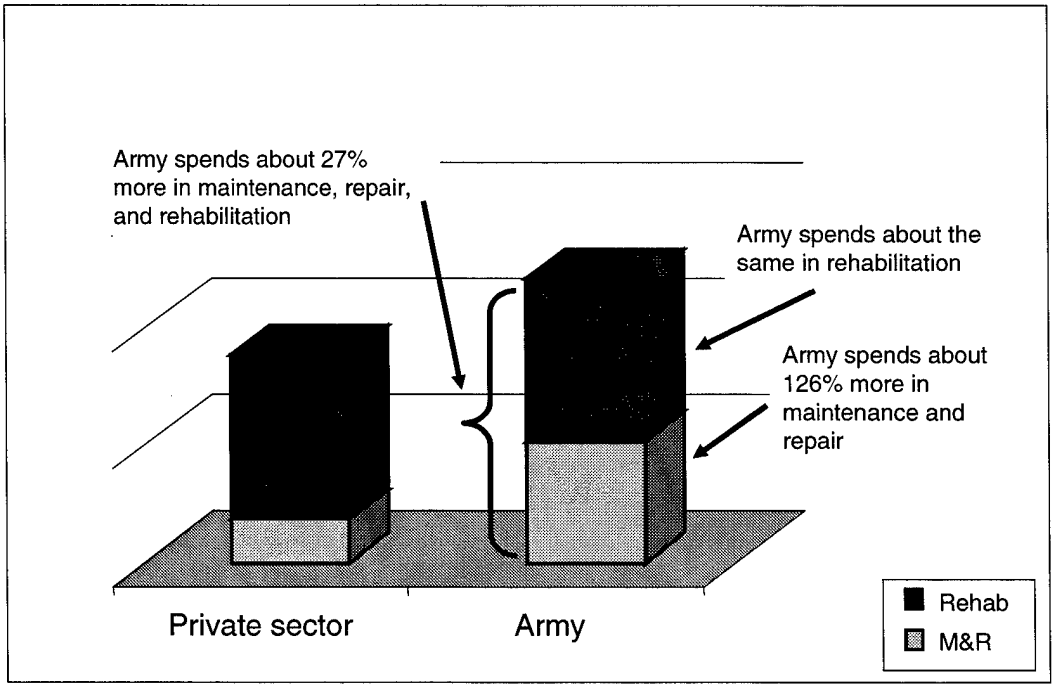
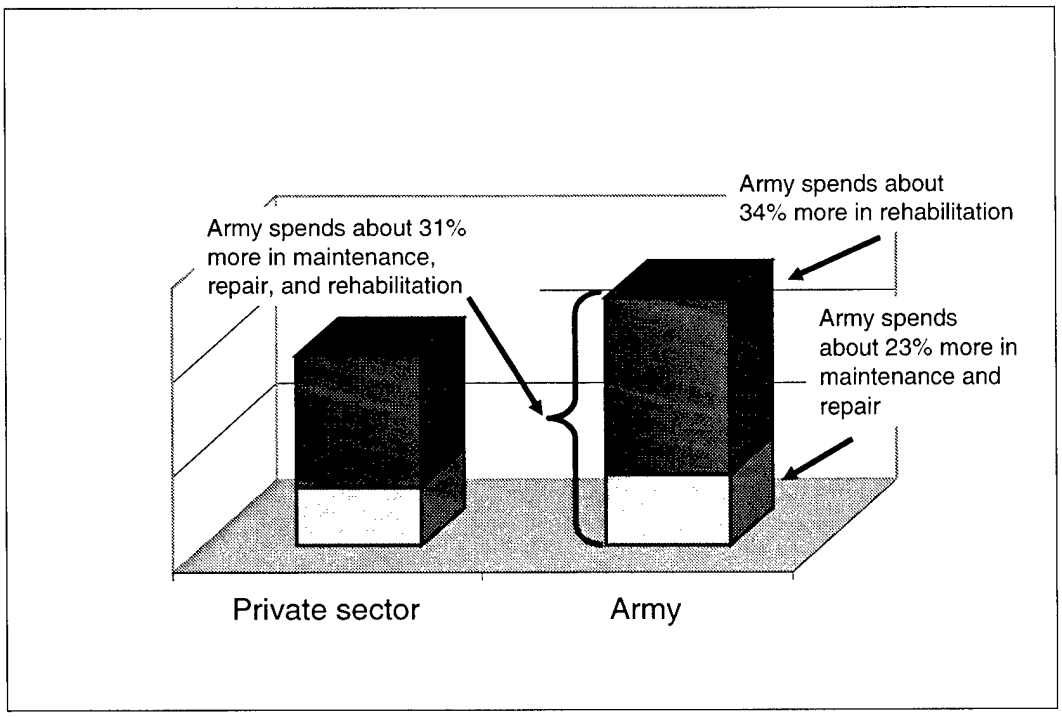


Figure 5-5. Net Present Value Cost Comparison—
Barracks and Administrative Buildings



For family housing, the Army spends

- 126 percent more than the private sector for M&R,
- the same as the private sector for rehabilitation, and
- 27 percent more than the private sector for both M&R and rehabilitation.

For administrative buildings and barracks, the Army spends

- 23 percent more than the private sector for M&R,
- 34 percent more than the private sector for rehabilitation, and
- 31 percent more than the private sector for both M&R and rehabilitation.

Budget Planning

Although Army Regulation 420-10 stipulates long-range budget planning for the management of facilities, it is not regularly done. Most installations do not find it useful because the allocations they receive never match the requirements identified in their budgets.

Construction and Maintenance Budgets

The major difference between private-sector and Army M&R is in their consideration of the life cycle of a facility—Army facilities are *not* managed as long-term productive assets. The Army does not include budgeting for M&R and recapitalization costs in the long-term planning of facilities. Specifically, the budget plan for construction is not linked to the budget plan for maintenance. The private sector carefully calculates the costs for M&R as part of the financial analysis in the planning phase and updates these data in the design and construction phase. The budget, which includes PM, serves as the basis for funding.

The Army's budget planning for new facilities and major capital renewal focuses on securing construction-related appropriations, and the budget planning for maintaining new facilities focuses on M&R funding. These two budgets are not tied together in any way. At no level, from installation to HQDA, do planners link a MILCON request with a projected funding stream for M&R. Thus, decisions for new construction are not based on whether a facility, once built, can be maintained adequately. Nor is there any consideration given to the potential impact of the facility's M&R requirement on the installation's future maintenance budgets and its overall condition profile.

Instead, it's taken as an article of faith that HQDA will fund the maintenance of the new facility. This faith persists, despite years of underfunded maintenance accounts and projections that the funding situation won't significantly change. In addition, commanding officers of installations routinely divert funds allocated for M&R to other priority needs. In private industry, in direct contrast, lending institutions require the developer to retain a maintenance reserve fund that is held in escrow to ensure continuous funding of M&R.

This problem is compounded annually. As installations continue to add space requiring M&R and M&R budgets continue to decrease (or receive less funding on the basis of existing requirements), the new *and* old facilities are not maintained properly. The lack of maintenance causes the facilities to have shorter life spans, requiring the construction of new facilities.

Installation Status Reports

Each year, installations identify the overall physical condition of their facilities on installation status reports (ISRs). The ISR can also provide details of the actions required to bring lower-rated facilities up to acceptable standards.

As noted earlier, each year the M&R funding levels decrease below the installation requirement. Current funding is provided on the basis of existing space allocations (and then reduced). This reduction has caused PM to be reduced—or completely stopped—and M&R work to be geared toward repairing only what the installation can afford.

At this time, the conditional report of the facilities is not linked to the budget process or requirement identification. Thus, there is no avenue for including the funding required to improve facilities that cannot meet their intended mission—Category 4 facilities. Consequently, public works staffs see no use in preparing long-range budget plans. They know they will never receive the funding levels (requirements) identified in their all-inclusive plans. Clearly, as M&R funding levels continue to fall below requirement levels, the condition of the facilities will continue to degrade.

Preventive Maintenance

All installations we visited, except one, have nearly eliminated all discretionary PM due to lack of funding and are repairing equipment as it breaks. Repair is expensive compared to PM. Greasing a bearing is much less expensive than replacing the bearing when it freezes up. Cleaning condenser coils on HVAC units is much less expensive than replacing the condenser when it fails.

Not only is repair maintenance more expensive than PM, but constant crisis repair affects the morale of the maintenance personnel, who told us they are always behind or playing "catch-up."

The impact on customers is much greater during repair maintenance than PM. Because something must fail to receive repair action, the users cannot schedule or plan around maintenance. The customers' daily jobs are affected when maintenance personnel are in their spaces or turning off larger systems to make repairs.

Staff Training

Most Army installations we visited, due to budget constraints, have foregone training of their maintenance staff. Consequently, many maintenance personnel are unqualified to repair the high tech equipment being installed in the Army's facilities. This lack of repair skills is very evident in the newer HVAC control systems. As the Army's maintenance work force grows older, with fewer new hires due to budget constraints, its personnel must be trained to maintain the expensive, high tech equipment.

Personnel training is ranked as the number one factor (of eight) affecting the quality of operations and maintenance.[5] As new facilities are built or older ones are upgraded, mechanical and electrical systems become more and more high tech. These upgrades are designed to make the buildings more energy efficient and less of a burden on the environment. For these new systems to work correctly and for the duration of their designed life span, the maintenance personnel must be trained in performing maintenance. An energy-efficient system that is not operating efficiently is an expensive capital investment lost.

[5] Arditi and Gunaydin, "Factors That Affect Process Quality in the Life Cycle of Building Projects," *Journal of Construction Engineering and Management*, May/June 1998, pp. 194–203.

Tracking Productivity

DPW managers usually don't measure or track the productivity or performance of their maintenance staffs. Without this tracking, they can't judge improvements within their staffing or compare themselves with other agencies or industries.

Tracking worker or shop productivity also allows managers to monitor their staffing and adjust their work force to meet the actual requirements. Carrying excess personnel is of great concern when budgets are shrinking.

Use of IFS-M and CMMS

The installations we visited use the IFS-M sparingly or not at all.[6] When installations don't track these M&R data for each facility, tracking expenditures or identifying facility operation costs is impossible. Computer maintenance management systems (CMMSs) also provide management with ways to track worker and resource productivity.

Government Credit Cards

Purchasing goods with government credit cards to meet "just-in-time" inventory is a good concept. However, with the numerous levels of approvals required before a credit card purchase can be completed, the timeliness and efficiency of the purchase is lost.

Contracts

The installations we visited contract out family housing maintenance. The user satisfaction survey results show that the occupants of family housing are generally happy with the service they receive from the contractors at their installations.

The family housing maintenance contracts replicate the structure of the in-house work force in place when they were written. They require the contractors to staff their crews with journeymen personnel. This top-heavy structure is inconsistent with that of the private sector, which uses handymen as first-line response.

When a family member requests that a light bulb be changed in a housing unit, a licensed electrician is sent because the maintenance contract requires all licensed electricians. The salary requirements necessary to staff this type of contract are much higher than if the contractor could staff with a handyman, a couple of apprentices, and one or two journeyman electricians. This contractual personnel requirement is one factor that increases the cost of the Army's family housing M&R.

[6] Fort Lewis, which bought and uses Maximo, is an exception.

Utilities

Little to no energy conservation is evident in family housing. Because the Army is paying the utility bills (with no metering), users have no incentive to conserve. In one location we visited, a family member was running a commercial laundry enterprise in her unit. With no utility bills to pay, we assume it was a profitable business.

Design Issues

Facility design plays an important part in the O&M phase of a facility's life span. The facility and its supporting systems must have a (preferably inexpensively) maintainable design.

Design Reviews

The Army and private sector encourage design reviews. DPWs have personnel from their maintenance staff sit in on design reviews. These maintenance personnel are not always trained for these reviews, which are clearly not their primary role, and the time spent takes them away from their already busy schedule.

The private sector hires professional firms to perform design reviews to identify potential issues with the facility and its systems. These independent parties are professionally trained and provide a valued service.

The construction materials identified in the design should also be reviewed for maintainability and life expectancy prior to finalizing a project. Ensuring the facility meets its mission is key, but it should also be reviewed to ensure that maintenance is feasible over its life span.

Initial Condition

The best practice is to use high quality, durable construction materials and install reliable, easy-to-maintain equipment. This reduces the M&R costs over the life span of the facility.

Common private-sector practice is to specify a particular type of equipment by name and model to ensure its reliability. The private sector can also specify a type of construction material, or even construction contractor, for building the facility. The Army is constrained in this practice by the FAR; consequently, it is plagued with problems of faulty systems, such as off-brand HVAC equipment. Faulty new equipment is the single most prevalent complaint we heard during our installation visits.

Condition Throughout Service Life

The private sector adequately finances capital renewal of its facilities. The idea is to properly maintain the structures and equipment until they are renovated or replaced. Although this can be costly in a specific year, private entities ensure they will have the financial resources to maintain their facilities via long-term budgeting and techniques such as a sinking fund.

As stated earlier, the private sector views its properties as business assets that contribute significantly to its mission. This is not an entirely new approach. The Disney Corporation, among others, has always recognized the profitability of land and facilities in its corporate planning strategies. As an asset, owned facilities are viewed primarily in terms of return on investment. Also, life-cycle cost is taken as the optimal criterion, incorporating the expected present worth of both inspection and maintenance strategies.

Amount of Space

The Whirlpool Corporation's real estate strategy identifies consolidating space and disposing of excess space as its top priority.

Within the Army, three factors tend to promote the demand for more space:

- *Budget planning for new facilities is not linked to budget planning for maintaining new facilities.* As new facilities are built, new maintenance requirements are not budgeted. With the RPM budget immediately cut down to 69 percent of the requirement, the Army cannot maintain its existing space. The addition of more maintainable space will affect the already tight M&R funding.

- *Requirements are not clearly defined.* The Army identifies space requirements in RPLANS. These data are based on historical criteria, not on market demand or the ability to pay for the space. As the Army is continually adapting its warfighting forces, it should also adapt its infrastructure to meet the new market demands.

- *Disposing of or adaptively using unneeded or underutilized property is costly and difficult.*

Disposing of Underutilized Property

Occasionally, facilities are built for newly arriving commands or tenants. However, tenants who leave existing buildings on the installation occupy most new facilities. When these occupants vacate their original facility, it either is used by other tenants or becomes underutilized space. Federal regulations require that the Army continue maintenance on these facilities as long as they are on the installation's manifest, regardless of their occupancy, a very expensive caretaking role.

One option is to dispose of the underutilized facility. The installations we visited all agreed that it is too expensive and time-consuming to dispose of property. DPWs do not want to spend their already depleted M&R funds for disposal, so they spend it maintaining underutilized space.

In the private sector, disposal or reuse of property is planned at the beginning of the facility's life. In fact, the second item on the Whirlpool Corporation's real estate strategy is "providing an exit strategy for all properties." Not only is disposal planned, it is budgeted throughout the life of the facility.

RECOMMENDATIONS

Asset Management

The overall process of the Army's facilities program is consistent with the private sector's—from planning through maintenance, repair, and rehabilitation. However, the private sector focuses on its facilities as long-term assets, while the Army has a "fire-and-forget" mentality—evidenced by the substantial interest in construction budgeting, planning, and building, but minimal attention on the planning, execution, and funding for M&R.

Because the funding for M&R is not tied to the budget process for construction, the installation has no definitive way to budget for M&R of a new facility and its impact on the existing facilities budget. The Army should adopt an asset management approach for all of its facilities.

Some public-sector organizations are starting to view their facilities as capital assets. The United States Coast Guard developed a new strategic initiative, Shore Facility Capital Asset Management (SFCAM), which will affect a business process that includes planning, investing, using, and divesting.[7]

The Coast Guard's SFCAM plan will focus on three initiatives, similar to those of many private-sector companies:

1. Transition Coast Guard shore support from a build and maintain only focus to a capital asset management focus;

2. Partner with the operational and support programs to align shore capabilities to the missions supported by them; and

3. Link investment decisions to service-wide strategy.[8]

[7] RADM Ronald Silva, P.E., Assistant Commandant for Systems, USCG, "Coast Guard: Capital Asset Management," *The Military Engineer*, March–April 2000, pp. 52–55.

[8] See Note 7.

LONG-TERM PLANNING

The Army does some long-term planning for facilities and infrastructure at its installations. These plans typically contain ideas and budget estimates for new buildings and renovation of existing facilities. Unfortunately, they do not include long-range budgeting for the M&R of new or existing facilities, nor do they include budgets for disposal of facilities.[9]

In contrast, the private sector analyzes a new facility project from the idea phase through the end of its expected life span. The analysis includes the cost of design and construction, M&R, and recapitalization for the life of the facility and the cost (or financial loss) associated with disposal. (Typically, the private sector handles disposal by selling the facility.) If the analysis shows that the facility will not be a productive asset throughout its lifetime, the private sector will not build it.

The Army's process tends to construct buildings to meet its needs and does not consider the long-term financial impact. The budget for construction is not linked to the budget for M&R.

Construction and Maintenance Budgets

As M&R funding continues to diminish, the Army must address it *before* beginning construction, preferably during the planning stages. This action requires linking congressional construction appropriations to O&M appropriations. This linkage—although a difficult process—must be effected to support the new (and existing) facilities for their projected life spans.

This new link must be an integral part of the planning and budgeting process from the HQDA to installation levels. Installation-level personnel must ask "Can I maintain this new building?" and HQDA must be able to answer "Yes" without jeopardizing existing M&R funds.

ISR and Budget

A facility's condition, as identified on the installation's ISR, should be directly linked to the installation's annual M&R budget. Funding requirements to upgrade Category 4 facilities, either through minor construction or M&R funds, should be included in the budgets submitted annually.

Each year, installations produce their ISRs to identify the overall condition of their facilities, which has steadily worsened. As stated earlier, the M&R budget has been too low to meet current M&R requirements.

If the ISR is not tied to the budget, funding will not be provided to make the facilities' condition acceptable. Current maintenance requirements can't be met

[9] We discuss the time frame and process for disposal in Chapter 6.

with the shortage of M&R funding, causing facilities to fall into disrepair (or further into disrepair) and making more facilities unacceptable.

M&R Budgeting

The following factors should be included in the budget preparation for M&R:

- Funding requirements based on existing facilities
- Projected funding requirements based on planned facilities
- Projected costs for improving Category 4 facilities
- Updated space requirements.

These factors will help identify the installation's true requirement. The installation and the tenant commands should review the space they currently occupy and consider the costs of M&R (and lack of funding) before producing requirements for additional space.

FACILITY SPACE ISSUES

Space Management

The Army currently uses RPLANS to identify how much space is allowed for its commands, including administrative, warehouse, barracks, and motor pools. The space allocation identified in RPLANS is based on historical data and not current market demands.

As the Army continues to find smarter, more efficient ways to fight and prevent wars, the quantity of required facility space changes. New storage space is required for new technologies, but as new technologies replace old, the older space requirements decline, either through reutilization or disposal.

With the realization that the Army may occupy more space than necessary, it should consider leasing the unused (and underutilized) property and space. Under the legal authority of 10 U.S.C. 2667, Leases: Non-Excess Property, the military departments can lease their real and personal property to nonfederal tenants on a long-term basis.

The Department of Veterans Affairs (VA), under its Enhanced Leasing Authority, has entered into leasing agreements for medical care and childcare facilities. The VA is currently reviewing over 80 leasing applications, including health care facilities, administrative office buildings, long-term and residential care facilities, parking facilities, and privatization of VA golf courses.

The Defense Authorization Act, Public Law 106-398, October 2000, enhances the DoD leasing abilities and should make the leasing of underutilized space more appealing for the Army. The following are changes resulting from this law:

- *Use of cash proceeds (subject to appropriation).* To apply lease revenues to facility related requirements (maintenance, repair, improvement, alteration, etc.), subject to appropriation.
- *Permit new construction with cash proceeds.* To use cash proceeds from leases for construction or renovation of its infrastructure and facilities.
- *Clarify types of authorized in-kind consideration.* To clarify that in-kind consideration may be applied at any military installation and that it may take the following forms:
  - Maintenance, environmental restoration, protection, alteration, repair, improvement, or restoration of any property
  - Construction of new facilities for the military departments
  - Provision of facilities for use by the military departments
  - Base operating support services
  - Other services related to the activity that will occur on the lease property.

Space Charges

Clearly, the Army needs space for its personnel, equipment, and materials. However, the quantity of space required and the efficiency of usable space is not tied to the budgetary issue of being able to afford that space. If a command were responsible for paying for its space out of its operating budget, would it be as interested in the quantity of space it currently has, or in acquiring additional space?

The private sector and many public-sector entities provide all types of usable space to their tenants and charge for that space. For example, the National Institutes of Health (NIH) has implemented space charges for the numerous tenants within its facilities.

The Army currently has a system in place that could be modified for use in charging the commands for their space and maintenance: the Army Working Capital Fund (AWCF).[10] Under the AWCF, maintenance costs would be linked to space demands, i.e., the activity pays rent for space it uses out of its revenues or budget allocations. The premise of this approach is to provide the occupant with incentive to conserve utilities and undertake minor repairs within its occupied

[10] See Chapter 8 for further discussion on the Army Working Capital Fund.

spaces. When its choice for additional space or modifications are constrained by fiscal reality (such as budget constraints), more reasonable decisions are made. At a local federal agency, when headquarters started charging its directorates for the amount of space they occupied, its directorates' space demand dropped 15 percent within the year.

The chargeable rent would be based on established levels of service for utilities and maintenance in "rentable" space controlled by the tenant/occupant. The levels of service can be negotiated with the DPW staff on the basis of (1) the level of service required and (2) how much the tenant/occupant is willing to pay. The tenant/occupant would bear the costs for services above the standard levels.

The level-of-service negotiations should not account for the existing DPW staff, but be based on market-driven factors. This would make the DPW staff responsible for providing the agreed-upon level of service as efficiently as possible, thus reducing its costs as well.

In addition, the Army should create a sinking/revolving fund. The sinking fund would be a revolving fund or "no-year" money financed via fee-for-service rents from units, activities, and housing occupants. The revolving fund would be used to finance maintenance, repairs, and recapitalization, as well those activities necessary to carry out disposal in a timely manner. The pertinent J and K account funds would be budgeted as "mission" OMA and available for rent payment. To establish this approach, Congress would authorize spending limits from the fund for maintenance, repair, and minor construction but would not *appropriate* the funds, but allow them to carry over from year to year.

Management Techniques: Best Practices

The Army should take a business approach to its M&R process, like the private sector. This approach should include measuring performance, cost-efficient techniques, maintenance personnel training, and delegating decision-making authority.

Measuring Performance

Measuring performance against other public entities and private-sector businesses will help the Army provide the best services at the most efficient cost. Tracking these measured costs can help the Army identify specific service areas that need improvement. Performance measurement is discussed in detail in the Office of Management and Budget (OMB) Circular A-76 study guideline and is being implemented at the installations we visited that are undergoing an A-76 study.

COST-EFFICIENT TECHNIQUES

The Army should use the most cost-efficient techniques to provide the best service, for example, using handymen to provide routine M&R instead of journeyman-level technical staff.

MAINTENANCE PERSONNEL TRAINING

To properly maintain the equipment and systems within the facilities, the Army should ensure its work force has up-to-date training. A national survey of 30 property managers and 31 construction managers identified personnel training as the most important factor (of 8) to affect quality in O&M.[11]

DECISION-MAKING AUTHORITY

The Army should delegate decision-making authority to lowest appropriate level. This would impact areas such as approval authority for credit card purchases, which would help in purchasing materials and goods for just-in-time maintenance.

[11] See Note 5.

Chapter 6
Property Disposal

INTRODUCTION

The disposal phase completes our prototypical 50-year Army life cycle. It generally lasts from 2 to 8 years and involves up to 30 personnel. In present value terms, it costs the Army, per disposal, about 1 percent of the original construction value. The primary cost driver is the environmental assessment requirements for the report of excess.

ARMY PROCESS

The Army disposal process begins with the identification of excess property and the preparation of a report of excess (ROE). The development of an ROE is the most time-consuming phase of the entire disposal process. Obtaining final approval of an ROE can take years, accounting for as much as 60 percent of time consumed by the disposal process. The report itself is a compilation of different studies and analyses. The following material is included in the ROE (the extent depending on the property):

- A general description, size, and any impact on installation resources and the local civilian community of the proposed property
- A notice of intent to relinquish the property
- An installation map showing the location of the proposed property
- Information on the nature and extent of congressional involvement in the disposal
- An environmental and decontamination analysis describing the type and cost of any decontamination required before disposal
- A care and custody plan that states the agency responsible for custody and accountability
- Statements on proposed disposal of improvements, including the condition prompting disposal, if the disposal is part of new construction, and whether any historic site is involved
- Statement of any restoration to be performed

- A summary of the post cemetery record and a list of cemetery or burial plots affected by the disposal
- Data on the potential or designed use of the proposed property
- A summary of any other factors affecting disposal.

The installation completes and submits the ROE to HQDA for approval. Upon approval, the Army screens all DoD entities for interest in the property. If another military service is interested, the Army will transfer the property to that entity. Otherwise, the Army will begin the process of having GSA dispose of the property.

Before any disposal takes place outside of DoD, Congress must specifically authorize sale and replacement proposals. Supported by the MACOM, HQDA submits the proposal to Congress, including a general description, the need for replacement, a completed DD Form 1391, and estimated proceeds of the sale. Upon congressional approval, the Army forwards the ROE to GSA.

Currently, on average, it takes GSA about a year and a half to dispose of property, including assessment and marketing. GSA conducts an economic impact assessment, then screens the property with other federal agencies, providers to the homeless, other public entities (like local and state governments), and educational institutions. Finally, GSA offers the property for sale to the private sector.

Several barriers inhibit the Army's streamlined and cost-efficient disposal of property, ranging from fragmented decision-making to resource shortfalls:

- The lack of centralized decision-making power has led to high infrastructure cost. Under the current process, as many as 15 to 30 staff members (at all levels in the Army, from installation to HQDA) and consultants can work on a single disposal case. Because of the numbers involved and fragmented decision-making process, communication between staffs is usually limited to work handoff and rework on ROEs.
- Installation commanders lack incentive to dispose of property. They are reluctant to dispose of any that may be needed in the future. Moreover, installations are more likely to find another use for the property (such as storage) than consider disposal.
- Limited resources and low priority complicate disposal funding. Funding available may cover the initial investigation but is unlikely to include time-consuming and costly environmental, historical, and contamination mitigation. Therefore, ROEs can be held in the pipeline waiting for funding for completion.

PRIVATE-SECTOR PROCESS

The private sector's disposal process consists of fewer steps than the Army's. Because the private sector treats all property as an asset and manages it accordingly, its disposal process begins with determining if the asset is economically and financially viable within its total asset portfolio. This determination includes defining business opportunities and focusing on market conditions, cash flow status, property, financial structure, and overall business goal. Also included in this assessment is research to identify all possible options for disposal, such as finding an alternative use, subleasing, buyout leases, sales, or allowing the property to deteriorate. During this assessment, brokerage firms are usually hired to help in assessing the current market conditions and developing marketing strategies. This up-front analysis provides the private sector a basis for their disposal decision. Once the disposal strategy is developed, the private sector takes quick action to execute the strategy and dispose of the property.

Private companies rarely keep statistics on disposal cycle times or costs because disposal of properties is a small part of their operations and not considered a core business. Most firms indicated that property disposal functions were either relatively small or handled by outsourcing. Also, companies tend to lease a significant amount of real estate, and the property disposal function includes lease terminations and subleasing. Many firms indicated that because of the small size, they did not have performance measures for property disposal. Others said that this type of information is closely held corporate data and not for the public release. Specific scenarios included the following:

- At Phillips Petroleum, property disposal is a small part of real estate organization. The disposal function mainly deals with sales or transfers of service stations. On average, they can dispose of the station within 3 months. Environmental issues are the main cause of disposal delays.

- Airports Group International (AGI) is a private owner/operator of commercial airport facilities around the world. Because of the need to maintain land as buffer zones and the cyclical nature of product flows, ports are often reluctant to dispose of property. AGI rarely disposes of property, preferring to lease it.

- The University of Texas System rarely disposes of campus property, preferring to lease available property rather than sell it. The university has a constitutionally provided endowment of land in West Texas, which can be sold to the fund the endowment. When commercial sales are approved, the sale price must be at or above appraised value.

- Port of Boston's property disposal function acquires property largely through tax foreclosures and occasionally through surplus. The typical process for disposing of a property involves an initial site visit to meet tenants, if any exist, and to assess the building's condition. Repair

requirements are identified such that, at minimum, the building can be sold. In some cases this means bringing the building up to code; in other cases, it merely means securing a vacant building. Once requirements are identified, the work is bid out to a contractor. This process has become streamlined, typically taking 1 to 2 weeks.

COST PERFORMANCE

Development of the ROE consumes the largest amount of time and cost in the current Army process. Although the length of time varies depending on the status of the property, the ROE can take years to complete, about 60 percent of the total disposal time. The key cost drivers are funding shortfalls, property condition, and decentralized decision chain of command:

- Available funds are a key cost driver for lengthy disposals. Without available funding, installations cannot complete the required ROEs. Resources are diverted to higher priority projects.
- Environmental mitigation is a key cost driver to lengthy disposals. Depending on the nature, mission, and history of the property, environmental documentation must be completed before the property disposal can be completed.
- With a fragmented decision-making process, rework is increased. ROEs are not completed correctly and documents transferred to HQDA and GSA are not complete.

BEST PRACTICES

Brokerage firms are integral part of the decision-making team that helps identify market conditions. Outside service providers are more frequently being asked to guide corporate officers through strategic planning and analysis on ways to maximize the value of their asset portfolios.

Since real estate can be an asset or a liability, corporations try to match the life cycles of business with the life cycles of real estate, constantly reevaluating their portfolios to find the most cost-effective and operationally effective way to use it. For nonmanufacturing companies, real estate is often the second or third largest overhead item. Therefore, applying asset management principles to real estate can help the profit-and-loss picture and balance sheet. Disposal begins with determining if the asset is economically and financially viable within its total asset portfolio.

The real estate chain of command is included in the company's strategic planning exercises. The trend is to look at occupancy costs within the framework of the

bigger corporate picture. Corporate real estate officers now report directly to the treasurer or chief financial officer.

Organizations are finding alternatives to owning property. For example, in order to divest itself of expensive maintenance costs but maintain historical preservation, the U.S. Coast Guard developed a corporate strategy to turn over some of its real property to a variety of private entities under the Maine Lights Program. In doing so, the Coast Guard saved approximately $4 million in M&R costs.

RECOMMENDATIONS

Several aspects of the Army's disposal process are prime candidates for improvements that will lead to a reduction in cycle time and cost. The Army should do the following:

- Create an integrated team (installation, MACOM, and GSA) to handle disposals for the entire process cycle. The team should determine potential disposal options, analyze market conditions, and write a strategic disposal plan.
- Establish a process of up-front economic analyses to determine the cost of maintaining property. These analyses should be the basis for deciding whether or not to initiate disposal actions.
- Increase the incentive for installations to dispose of or look for alternative uses for underutilized property.
- Provide adequate funding to cover the entire disposal process, not just the initial reviews. The funding request should be supported by findings develop in the up-front analysis.
- Ensure that Army regulations are on par with private standards to help expedite sale of property by reducing the need for any rework or additional work.

Chapter 7
Findings and Conclusions

FINDINGS SUMMARY

In each of the previous five chapters, we analyzed a different phase of the Army's facility construction and maintenance process and compared it with the corresponding phase in the private sector's equivalent. In this chapter, we present a brief summary of the key findings reported in those chapters.

In general, the Army and the private sector follow the same process in planning, designing, constructing, and maintaining their facilities, but some differences exist. In the planning phase, the private sector, because of its emphasis on market and financial analyses, prepares accurate cost estimates of its proposed construction projects. Thus, unlike the Army, it rarely must scale down the design of its construction projects later in the process because of a low "program estimate." In the design phase, the private sector completes its designs in less than half the time of the Army's 2-year cycle. Army construction costs are generally higher than the private sector's, especially for barracks and administrative buildings. Also, management practices for O&M, as well as disposal, are frequently dissimilar. Table 7-1 shows the significant differences.

Table 7-1. Comparison of the Army and Private-Sector Processes[a]

Phase	Cost	Time	Quality
Planning	Not comparable (insufficient reliable data).	Generally longer	Private sector prepares more accurate initial cost projections; integrates initial cost estimates with capital renewal (maintenance, repair, and rehabilitation.
Design	The Army spends about 6% more than the private sector for design in percentage of program cost. The higher spending level relates to the cost of legal and regulatory compliance.	More than twice as long.	Private sector trend—shorter intended-use design horizons and simpler, less restrictive designs that permit firms to economically adapt their facilities to changing demands and emerging technology.

Table 7-1. Comparison of the Army and Private-Sector Processes[a] (Continued)

Phase	Cost	Time	Quality
Construction	Family housing—the Army spends about 9% more per square foot than the private sector for construction. The higher spending relates to the cost of complying with legal and regulatory requirements.	Comparable.	Family housing—quality level varies substantially (from average to above-average).
	Barracks and administrative buildings—the Army spends about 24% more per square foot than the private sector for construction: • About 9% of the higher spending relates to the cost of legal and regulatory requirements. • About 15% relates to a combination of the costs of market imperfections for some construction services and the costs of coping with Army red tape.		Quality level below private sector.
	Construction management—comparable.	Comparable.	Roughly comparable to the private sector.
	Supervision and administration—comparable.	Comparable.	Roughly comparable to the private sector.
O&M	Family housing—the Army spends about 27% more than the private sector for maintenance, repair, and rehabilitation per square foot over the life of the facility. • About 126% more on annual maintenance and repair; • About the same for rehabilitation over the life of the structure.	Comparable.	Army family housing maintenance is comparable with private sector, but maintenance quality for Army barracks and administrative buildings is lower.

Table 7-1. Comparison of the Army and Private-Sector Processes[a] (Continued)

Phase	Cost	Time	Quality
	Barracks and administrative buildings—the Army spends about 33% more per square foot than the private sector for maintenance, repair, and rehabilitation over the life of the facility: • About 23% more on annual maintenance and repair; • About 36% more on rehabilitation over the lives of the structures.	Comparable for emergency repairs; longer response time for lower priority repairs.	
Disposal	Not comparable (private sector process is less extensive).	Generally 2 to 3 years longer.	Not evaluated.

[a] We compared three types of facilities: family housing (Department of Housing and Urban Development standards), barracks (equivalent to university dormitories), and administrative buildings (2- to 4-story standard, 25,000 square feet).

As depicted in the cost column in Table 7-1, the Army typically spends more than the private sector in the design, construction, and maintenance phases. Figure 7-1 shows those differences for family housing, and Figure 7-2, the differences for barracks and administrative buildings.

Figure 7-1. Cost Differences between the Army and the Private Sector by Phase for Prototypical Family Housing

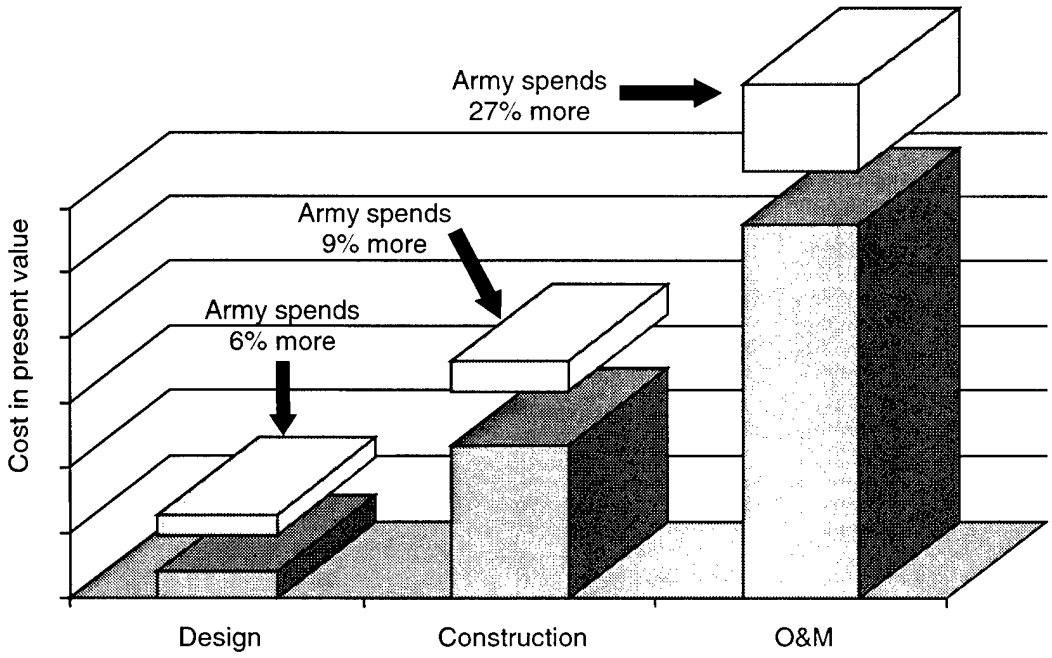
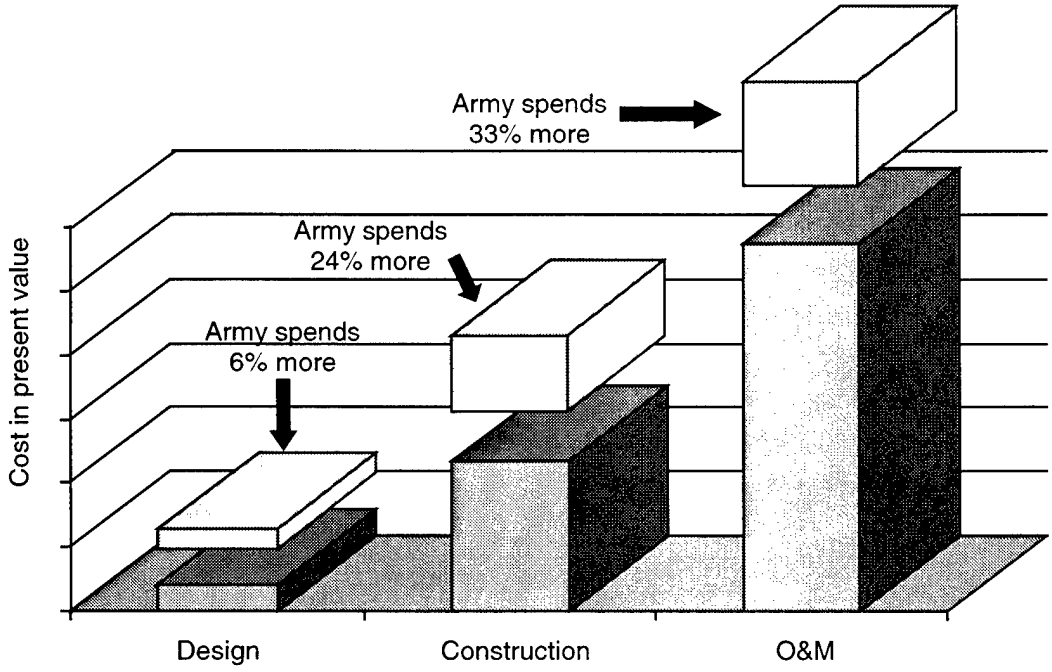


Figure 7-2. Cost Differences between the Army and the Private Sector by Phase for Prototypical Barracks and Administrative Building



CONCLUSIONS

The differences between the Army and the private sector are significant, especially in the areas of budget allocation and management practices. Unlike the private sector, the Army tends to build more facilities than it can afford to maintain. The Army's operating environment, which we discuss below, is the primary cause. We follow this discussion with a review of a set of countervailing principles, or key success factors, that guide many in the private sector (and some in the public sector) in their pursuit of effective facility management.

Operating Environment

The Army is a public entity, not a commercial firm, and its objective is different, as is its operating environment. Instead of seeking to maximize profits (or, more precisely, to create wealth) as a commercial firm does, the Army seeks to provide a service (i.e., national defense) within appropriated budget levels. There is no marketplace to help the Army determine an efficient allocation of resources.

Thus, allocation rules and political decisions, not market forces, drive the demand or requirement for facilities in the Army. Moreover, without the competitive forces of a market place, the Army has little incentive to minimize costs as long as it has the budget to spend. Consequently, institutional factors affect how the Army implements its facility construction and maintenance process. Four institutional factors help explain the primary difference between the Army and the private sector.

BUDGET-YEAR FOCUS

The primary difference between the Army and private sector is in the financial management planning horizon. The private-sector organization views its facility requirements from a life-cycle perspective and manages its cash flow accordingly. For example, it will create a long-term financial plan that considers not only the investment costs of building a facility but also the revenues needed to maintain it (and cover any related debt service it may have as well as a return on its investment). Once the facility is constructed, the organization aggressively manages its financial plan to ensure that building maintenance is adequately financed.

The Army does not take a long-term financial management approach. Instead, it focuses on a 1-year budget horizon. Any consideration of maintenance requirements that is part of an economic analysis justifying a MILCON request is not linked to future maintenance budget plans. Thus, the installation requesting the project has no meaningful basis for determining whether it will be able to afford the maintenance of a new facility following construction.

In the private-sector organization, the inability to demonstrate adequate funding for maintenance is a deal breaker. The absence of a financially sound maintenance

program makes financing improbable. Corporate headquarters will not approve such a project. In contrast, the Army continues proposing new construction projects in its annual budget despite its own recognition that it cannot adequately finance the maintenance of its existing facilities.

This situation is aggravated when, during congressional budget deliberations, some Senators and Members of Congress compel the Army to increase its overall construction program by inserting funding in the upcoming year's budget for previously unplanned new Army MILCON projects. The additional funding for the new projects is just for the construction phase and does not cover the cost of maintaining the new facilities once they are built. Moreover, in some cases, the additional funding does not even cover the full cost of construction.

At the installation level, the budget-year focus helps explain two typical situations in which long-term cost efficiency in facility maintenance suffers:

- Installations divert some of their budgeted maintenance funds to other, more urgent needs, thus leaving some previously planned maintenance needs unmet.
- Installations opt for relatively low-cost, temporary repairs (that may be repeated frequently in subsequent budget years) instead of longer-term, but more costly, permanent remedies.

Requirements and Restrictions

The Army must comply with numerous legal and regulatory requirements that a private-sector firm, working on nonfederal government projects, would not normally have to meet. These requirements fall into four broad areas:

- Social actions, such as those dealing with equal opportunity and clean air
- Cost control and accountability requirements, such as those regarding audits and record keeping
- Business protection requirements, such as those in the Buy American Act
- Labor statutes, such as Davis-Bacon Act requirements.

Compliance with these legal and regulatory requirements adds about 6 percent to total Army design costs and about 9 percent to Army construction costs.

In addition, Army commanders and managers face a number of institutional restrictions that inhibit management actions. These restrictions are more prevalent in areas dealing with civil service, procurement, and budgeting issues. Army managers can neither reward good performance nor penalize poor performance to the extent that their private-sector counterparts can. Compliance with the Army's relatively cumbersome and time-consuming procurement rules typically precludes

a manager from selecting materials and installed equipment by brand name. Budget restrictions, such as those inhibiting the transfer of funds from one appropriation to another, tend to limit an Army manager's flexibility in buying goods and services.

In addition, the Army's institutional bias toward risk aversion lends itself to the creation of detailed internal processes and procedures (red tape). For example, at some installations, staff members with the authority to use a government credit card for small purchases still need to obtain two to three layers of authorization before they can do so. Also, design specifications for Army construction are far more detailed than the specifications for similar construction in the private sector. Moreover, the Army's paperwork requirement for its construction contractors throughout the construction phase is far more detailed than in the private sector.

Lack of Incentive

While commanders and managers have obligations to be good stewards of military property, they have little incentive to minimize the costs of maintaining facilities. They are neither responsible for the maintenance of the facilities that their organizations occupy, nor do they pay for the utilities and maintenance of those facilities—either through a rent or budget transfer. Similarly, residents of family quarters typically do not pay for utilities. Thus, they too have no incentive to economize on their utility consumption.

Even the budget process works against cost minimization. Budgets for real property maintenance are allocated to installations on the basis of facility area (e.g., building square feet). Consequently, there is no fiscal incentive (at the installation level) to reduce facility space. If an installation did dispose of building space, its budget for real property maintenance would be reduced commensurately. So there would be no net gain in its real property maintenance budget.

Facility Management Strategies

In response to years of severely constrained maintenance budgets, most installations have adopted reactive maintenance strategies. They deferred all but the most urgent PM and stopped personnel training. Instead, they concentrate on responding to facility breakdowns. Also, the installations stopped long-range planning and budgeting. Instead, they wait until they receive their annual budget and figure out what they can afford to do. These strategies run counter to the practices in the private sector, where PM, well-trained technical staff, and management control were paramount.

Key Success Factors

A set of principles, or factors, set the private sector (and some entities in the public sector) apart from the Army in its management of facility construction and maintenance. These strategic factors focus on meeting an organization's facility

construction or maintenance needs, while minimizing facilities-related life-cycle costs, rather than on meeting short-term budget needs:

- *Thorough planning to define project scope and develop accurate budget estimates early in the planning process.* In its planning phase, the private sector focuses extensively on identifying its facility needs and in developing accurate estimates to meet those needs. Thus, early in the process, it can identify the right amount of finances it must either borrow or earmark from its cash reserves for the construction project. As a consequence, the private sector rarely needs to scale down the scope of its project later in the design process because it underestimated the cost of the project.

- *Commitment to adequately fund capital renewal.* When a private-sector organization commits to the construction of a new facility, it also commits to adequately finance not only routine maintenance and repair of that facility, but also the necessary major repairs to keep the facility in good working order.

- *Emphasis on flexible building designs that can be adapted quickly to meet new demands and changing technologies relatively inexpensively.* The watchword is flexibility. The private sector recognizes that rapid and frequent change in technologies and unpredictable shifts in its markets will make many of its current and planned facility configurations inefficient in relatively short order. Planning horizons are now down to under 10 years. Now the private sector is choosing very basic facility designs that allow it to reconfigure internal layouts quickly and relatively inexpensively.

- *Allocation of space to activities on the basis of affordability.* The less space that needs to be maintained, the lower the aggregate maintenance costs. Thus, to keep maintenance costs under control, the private sector limits the amount of facility space it allocates to corporate and subordinate activities. Typically, the allocation is based on affordability, i.e., on the principle that the need for space must justify the cost of maintaining it.

- *Functions that are not core business functions, such as facility operations and maintenance, are contracted out.* Many firms have decided to focus on their core business functions and to contract out those support functions that are necessary, but not core to the business. These firms establish performance objectives for their facilities O&M and hire property management firms to meet those objectives.

- *Decision-makers are given adequate authority for hiring, rewarding, and punishing their work forces.* If the private sector chooses to maintain its facilities with in-house staff, it ensures that the facility managers have substantial influence in personnel-related staff actions that tend to promote excellent performance or, at least, compel at satisfactory performance.

- *Commitment to invest adequately in training of in-house maintenance staff.* If the private sector chooses to maintain its facilities with in-house staff, it ensures that those staff members are adequately trained to maintain and repair their facilities, including the high-technology building equipment and energy saving devices.

- *Adoption of maintenance strategies that emphasize PM.* It is standard practice in the private sector to perform PM. Indeed, it is viewed as not only foolish to forego performing PM, but also cost-inefficient on a life-cycle basis.

- *Elimination of overly restrictive procurement strategies.* If the private sector chooses to maintain its facilities with in-house staff, it empowers its managers and supervisors through appropriate levels of authorities to buy maintenance-related goods and services with the minimum of red tape.

- *Establishment of performance objectives and use of management systems for tracking and controlling performance.* The private sector recognizes that its finances and operations are integrally connected. Thus, whether it operates and maintains its facilities with in-house staff or through a contracted property management firm, it establishes financial and other performance objectives, then constantly tracks and controls that performance to ensure the objectives are met.

In the next chapter, we build on these success factors and present our recommendations for adding value to the Army's facility construction and maintenance process.

Chapter 8
Recommendations

In the previous chapter, we highlighted our findings, identified the primary cost drivers, and presented a set of key success factors. It may not be feasible, from either a political or an organizational standpoint, to eliminate all cost factors and incorporate every success factor in new facility management policy, but the Army can take actions to reduce costs, shorten cycle times, and improve quality and user satisfaction. We identify and recommend these actions in this chapter.

Our recommendations flow directly from our conclusions and incorporate many of the key success factors. We present them below by process phase. We precede each recommendation with the specific problem area it addresses. We also identify potential obstacles to implementing each recommendation and our prognosis on the recommendation's relative impact in adding value to the Army's facility construction and maintenance process.

PLANNING PHASE

We make two recommendations for improving the planning phase. One recommendation is intended to improve the requirements determination process, the other, to balance capital investments with the Army capability to maintain the investments.

Requirements Determination

The Army does not thoroughly define project scopes or develop accurate budget estimates early in its planning process. Consequently, it must reduce the scope of some projects during the design phase so that construction costs do not exceed insufficient programmed estimates.

To avoid this problem, the Army should amend its requirements determination process in two ways:

- Increase the use of planning *charrettes* (i.e., major planning review sessions of planners, designers, and user representatives) as a means of developing detailed user requirements.

- Prepare parametric design cost estimates for its projects, then include them in the project justification documents. We describe each method in turn.

PLANNING CHARRETTES

For all but small or common repair or construction projects, the Army should increase the use of planning charrettes at the installation level. These planning charrettes would permit an installation to more accurately define user needs in the process, thus giving an installation a better basis for preparing program costs estimates. Consequently, the quality of planning will improve. Moreover, user satisfaction in the planning process should increase, as facility users gain a greater sense of involvement in planning for their facility. When it can be justified as a planning and design activity, USACE participation at the charrettes should be financed from the P&D MILCON account.

Managing USACE's participation in the planning charrettes will be a major potential obstacle to implementing this recommendation. Given limited budgets (for either O&M or P&D), some headquarters level must decide whether USACE's participation at each particular charrette is warranted and affordable. HQDA is at too high a level to make that decision; thus, we recommend that the major commands manage the effort. They could be allocated a portion of the (proposed) charrette funding subaccount and be responsible for financing and overseeing USACE's participation at their installations.

PARAMETRIC DESIGN COST ESTIMATES

After user needs are fully defined, the Army should require installations to provide parametric design cost estimates in their (DD Form 1391) project justification documents. Since they are derived from approved Army cost factors, these estimates could be used as budget estimates. Consequently, the first year of the 2-year design cycle would not be needed, and, because of this reduced design cycle time, high priority projects could be submitted 1 year earlier to Congress for approval.

As with the planning charrette recommendation, managing the funding of performing parametric design cost estimates at the installation level requires a different management approach, especially if the installation needs assistance from USACE. To overcome this potential problem, we recommend that HQDA establish another subaccount from its P&D MILCON account. This subaccount would be used for funding USACE's participation in performing parametric design cost estimates at the installation. This subaccount, like the charrette subaccount, could be allocated to the MACOMs, which would manage the funding and coordinate USACE's support.

POM Development

The Army has over 161,000 buildings, and its 6-year MILCON program projects the construction of more facilities every year. Yet, as evidenced in its FY01 budget request, it can afford to finance only about two-thirds of its real property

maintenance requirement. Clearly, the Army has more buildings than it can afford to maintain.

To ameliorate this problem, the Army, during POM development, should integrate the O&M cost estimate for maintaining a facility with the MILCON cost estimate for building it in a single programming account, an MDEP, and consider the full program cost impacts before deciding whether to add the construction project to the Army program.

This change to the current programming approach for MILCON would better inform decision-makers of the out-year fiscal impact of MILCON requests. In principle, the Army would not add MILCON projects to its program that are viewed as unaffordable in the out-years. This situation would help balance the current situation in which the Army's physical plant is undermaintained. As the Army restores balance in its funding profiles for building facilities and then maintaining them, quality of maintenance will improve, as will user satisfaction.

To implement this recommendation, HQDA would have to slightly modify its current approach to POM development. In particular, a more detailed accounting of the O&M funding associated with its facilities would be required. HQDA would have to make tradeoffs in the program's out-years to accommodate MILCON requests.

DESIGN AND CONSTRUCTION PHASES

The Army should amend its design and construction processes in four ways:

- Focus more on flexible building designs.
- Institute and incorporate the use of web portals in its design reviews.
- Establish a range of standardized features for family housing.
- Rely more on the design-build delivery approach.

Flexible Building Designs

Unlike many private-sector firms, the Army cannot quickly or inexpensively adapt its structures to met new or changing demands in the workplace. Thus, the Army should emphasize basic building designs with shorter intended-use design lives. Following this approach, the Army could modify its facilities quickly and relatively inexpensively to accommodate new technologies and unpredictable changes in missions that are likely in the short term. The installation would have more flexibility to adapt or modify the quality of its facilities, resulting in greater user satisfaction.

The Army may find internal resistance to adopting this untraditional approach.

Web Portals

Army installations eagerly participate in numerous design reviews during the design process. Yet, in many cases, the installation staff members responsible for reviewing the mechanical and electrical designs lack the time or skills (or both) to adequately examine those design documents during the review sessions. Thus, some design flaws that experienced tradesmen or engineers would typically identify are not caught early in design and, subsequently, increase maintenance costs after the facility is built and brought on-line.

To help the installations alleviate this problem, the Army should create Internet web portals that would permit installations to connect directly with USACE expert assistance centers to facilitate mechanical and electrical design reviews. These portals would allow installations to access expert reviewers of mechanical and electrical designs of construction projects quickly and inexpensively. This approach could improve the effectiveness of design reviews in the two design areas—mechanical and electrical equipment—that have been a problem for the Army. By identifying and correcting potential design flaws before construction begins, the Army should have fewer design-related problems in maintaining its equipment, thus reducing life-cycle costs for equipment maintenance and replacement.

To implement this recommendation, USACE would have to create centers of expertise at its divisions or districts for the design reviews.

Standardized Housing Features

Construction costs for Army family housing vary substantially among installations due to differences in the number and type of features designed for different housing complexes. Consequently, housing quality levels vary.

To reduce the variances in construction costs, the Army should establish a range of standardized features for its family housing designs. The Army should then direct its designers to select features only from that range for use in housing design and construction. By standardizing the range of features, some construction costs will be reduced because levels of quality will be more uniformly distributed throughout the Army.

This recommendation would limit the amount of design control currently exercised at installation level.

Design-Build

The Army pays considerably more for the construction of its barracks and administrative buildings than does the private sector for comparable structures. The cost differences stem from the costs of

- compliance with legal and regulatory requirements,
- imperfections in the marketplace for some construction services, and
- the extra contractor time required to cope with Army red tape.

While the Army may have to accept higher costs relating to complying with legal and regulatory requirements, it can reduce costs by eliminating some of the conditions that lead to market imperfections and excessive red tape. One approach involves the use of the design-build method of construction procurement instead of the more traditional design-bid-build approach.

The Army should aggressively implement its current guidance on using the design-build project delivery approach. Design-build will increase the ease of constructibility because of the continuity of responsibility for designing and building a facility. Also, through the design-build approach, the Army can expect few change orders and construction claims. This approach should also yield savings in overall construction costs, improved quality in design and construction, and ultimately improved user satisfaction.

Installations might resist changing to the design-bid approach. Key staff members may think that, under this approach, the installations forfeit too many design decisions to the contractor.

O&M PHASE

The Army should amend its O&M process in three ways:

- Establish a user fee (a rent-like space charge).
- Create a working capital fund to finance its public works operations.
- Invigorate or institute effective property management practices at the installation level.

Facility User Fee

The Army's operating environment does not promote cost economies in space usage or utility consumption. Although commanders and managers have obligations to be good stewards of military property, they are not responsible for the maintenance of the facilities that their organizations occupy, nor do they pay for

the utilities and maintenance of those facilities—either through rent or budget transfer. Thus, they lack the incentives found in a competitive market, in which maintenance providers or property owners or renters tend to economize as a means for getting their money's worth out of their maintenance services. Similarly, residents of family quarters typically do not pay for utilities, so they too have no incentive to economize on their utility consumption.

To create incentives for cost economies, the Army should require installations to charge units and activities a user fee for use of their facilities. This rent-like charge should be priced to cover the O&M costs for the occupied facility space, including the costs of projected capital renewal projects (e.g., periodic roof repair and electrical system upgrades). Prior to the beginning of each fiscal year and on the basis of expected budget levels, the installation and facility users would enter into a occupancy agreement that establishes the user fee and associated level of services that the fee would cover.

By instituting a user fee that facility occupants (units and activities) would pay for using their facility space, the Army could create market-like forces that would promote economies in space usage and utilities consumption. These forces will stem from unit commanders and activity directors deciding how much of their budget they want to spend on O&M in relation to how much they want to spend on other activities. These market-like forces should lead to cost reductions in O&M as the commanders and director economize on utility consumption and minimize the amount of facility space they use so they can spend more of their budget on other priority needs.

This recommendation runs counter to the Army's operating culture, which will inhibit implementation. Commanders and directors have traditionally viewed usage of facility space on an Army installation as a free good—something that they have not had to pay for directly from their budgets. As such, they tend to use as much of space for their units as they can justify on a fiscally unconstrained "need" basis. They will not want to change to a new approach that compels them to make budget choices between facility usage and other needs.

Working Capital Fund

The Army lacks a stable base of funding to meet user demands for real property maintenance, including capital renewal projects. Frequently, at the beginning of fiscal years, portions of budgets earmarked for real property maintenance are diverted to finance other needs. Also, many installations apportion real property maintenance budgets incrementally over a fiscal year, typically keeping a major portion in reserve until late in the fiscal year—just in case the installation might choose to spend that budget for other activities. Moreover, the installation cannot carry over any remaining real property maintenance funding from one fiscal year to the next. Thus, accumulating the funding needed for major rehabilitation projects over time is not feasible.

To create a stable base of funding, the Army should establish a working capital fund for all public-works-related base operations support. This fund would be used to finance four of the DPW's functions:

- Operation of utilities
- Maintenance and repair of real property
- Minor construction
- Engineer support.

The primary source of revenues for this working capital fund would be the user fees (the rent-like space charges proposed previously) collected from organizations occupying facility space on an installation.

A working capital fund for base operations support would permit the Army to manage its facilities-related resources more efficiently—with total cost visibility and full cost recovery. The Army would gain efficiency by maintaining a stable base of funding to meet user demands for real-property-related O&M, including periodic capital renewal projects. Following this recommendation will reduce maintenance costs and shorten response times. Public works directorates, financed through the working capital fund, will have the requisite resources to perform the right levels of repair the first time instead of carrying out numerous, low-cost "patch" jobs that, in the long-run, are relatively more expensive. Consequently, the quality of repairs will improve, which, in turn, will increase user satisfaction.

The Army will probably have to create a new working capital fund because its current working capital funds are not related to real property activities.[1]

Property Management Practices

With minor exception, installation DPWs have adopted a reactive maintenance strategy that minimizes PM, work force training, and management control. This strategy has contributed to higher costs and lower quality in performing maintenance activities. To rectify this situation, the Army should invigorate (or, as needed, institute) effective management practices at the installation level. Five of the more significant practices that ought to be revitalized are as follows:

- *Developing long-term plans and budgets based on installation needs and projected funding levels.* This practice will become essential if the Army adopts the recommendations to charge user fees to organizations occupying facilities on an installation. Otherwise, installations will have no useful basis for determining rates for the user fees.

[1] The Army has four working capital funds: Supply Management, Depot Maintenance Ordnance, Depot Maintenance Other, and Information Services. The authority for creating and operating a working capital fund is 10 U.S.C. 2208, Working Capital Funds.

- *Establishing facility management performance objectives.* This practice will help focus and guide actions within a DPW. It will also establish a basis for the directorate and its customers to determine whether the directorate is performing well. Both conditions should help the DPW improve its internal management operations.

- *Implementing maintenance strategies that not only support meeting performance objectives, but also promote long-term efficiencies.* These include performing PM, ensuring that its work force is adequately trained, and contracting out to supplement an in-house work force during surge periods. These strategies, which are commonly followed in the private sector, would help the Army achieve cost efficiencies and quicker response times. In turn, user satisfaction will increase.

- *Revitalizing (or developing) management control techniques and systems for ensuring the attainment of performance objectives.* To be effective in performing its real property management functions, the Army must update its archaic CMMS and dust off its moribund management review and analysis techniques so it can not only track and evaluate its internal performance, but also take appropriate corrective action.

- *Attracting nonfederal tenants to lease underutilized facility space under the enhanced use leasing authority of 10 U.S.C. 2667.* Under the enhanced use leasing authority, a leasing installation can use the proceeds (or in-kind consideration) from leasing property to nonfederal tenants as an additional source of revenue to offset its costs for real property maintenance.

COST-BENEFIT

To assess the potential impact of the recommendations, we projected the potential costs and benefits of implementing them. To establish the framework for our projections, we established an aggressive, yet achievable, set of target objectives:

- Reducing the construction cost differential between the Army and private sector by 20 percent by FY08

- Reducing the M&R cost differential between the Army and the private sector by half by FY08

- Reducing the equivalent annual rehabilitation cost differential between the Army and the private sector by 10 percent.

We then assumed that the Army would have two major investments in implementing the recommendations:

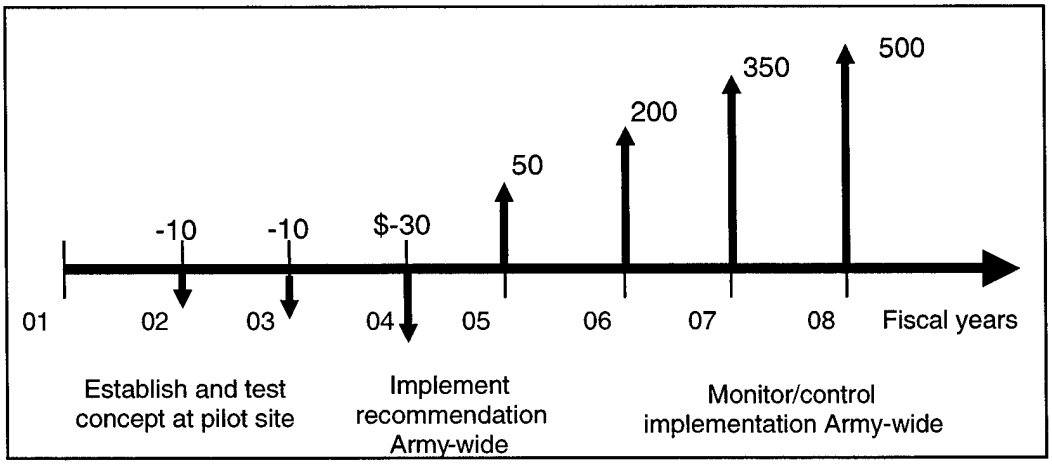
- *The establishment of the user fee and the creation of a working capital fund.* This investment would be spread over a 2-year period as the Army

creates a plan, tests it at a number of pilot sites, and then implements the new procedures throughout the Army.

- *The revitalization and upgrade of IFS-M.* This investment would improve the Army's CMMS to enable Army public works managers to better track and control performance and productivity.

We assume that the other recommendations could be implemented at minimal cost. Thus, by FY05, the Army will begin recouping its investment, and, by FY08, it will achieve savings at a steady state of $500 million dollars per year.[2] These projected savings can be used to reduce backlogs within the real property management accounts. Figure 8-1 presents the projected cash flows.

Figure 8-1. Cash Flows from Recommendation Implementation ($ million)



Given our projections, the Army's breakeven point occurs in FY04, and the benefit-cost ratio is 17.6—a very favorable ratio.[3]

SUMMARY

The Army and the private sector follow similar steps in their corresponding facility construction and maintenance processes. However, they differ in how they carry out their processes, especially in the areas of budget allocation and management practices. These differences result in higher costs for the Army in the design and construction phases of its process, as well as higher costs and lower efficiency in the O&M phase. The primary causes are rooted in the Army's operating environment. As a public-sector entity, it does not encounter competitive market forces that tend to shape efficient organizational behavior and mandate

[2] See Appendix H for a more detailed description of how we project the costs and benefits.

[3] The benefit-cost ratio is defined as the present value of cash inflows divided by the present value of cash outflows. Since the cash flows are represented in nominal dollars, we used a 6 percent discount rate, as recommended in Appendix C to OMB Circular A-94 (January 2000).

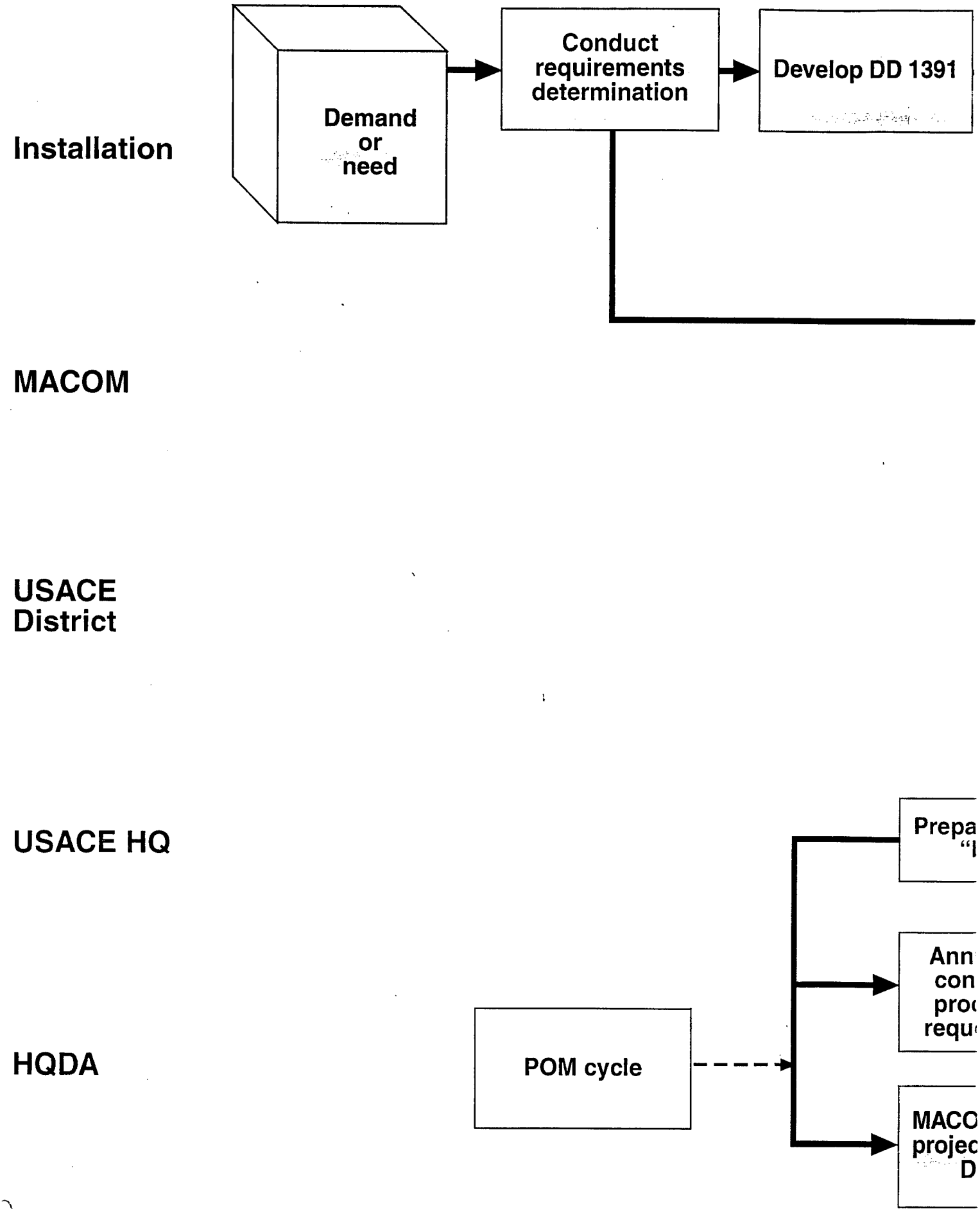
sound financial and organizational management. Consequently, Army budget allocation decisions and current management practices promote a situation in which it builds more facilities than it can afford to maintain.

Implementation of our recommendations for improving the Army's facility construction and maintenance process will ameliorate that situation. The Army will not only reinstitute sound management practices that promote more effective planning, programming, and budgeting of construction projects and maintenance activities, but it will also create a competitive-market-like climate that encourages economies and efficiencies. The result will be long-term cost economies, reduced cycle times in the design and maintenance phases, and better quality and increased user satisfaction in all phases of its construction and maintenance process.

Appendix A
Army Facilities Life-Cycle Process

This appendix contains figures depicting the Army's facilities life-cycle process. Figure A-1 is an overview of the entire life-cycle process, and Figures A-2 through A-6 show process details for the five phases of the facilities life cycle: planning, design, construction, operations and maintenance, and disposal.

Figure A.1 Planning Phase



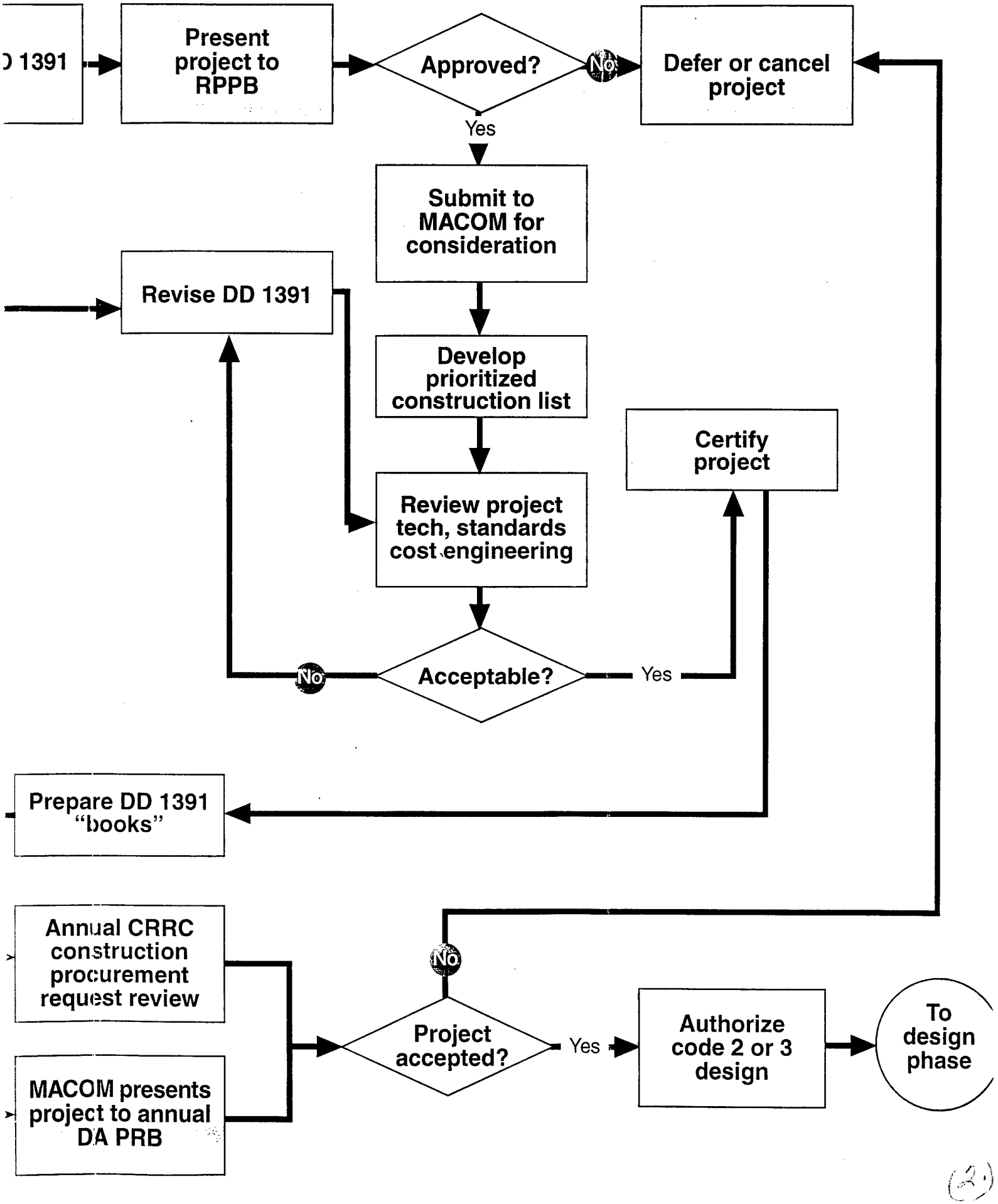
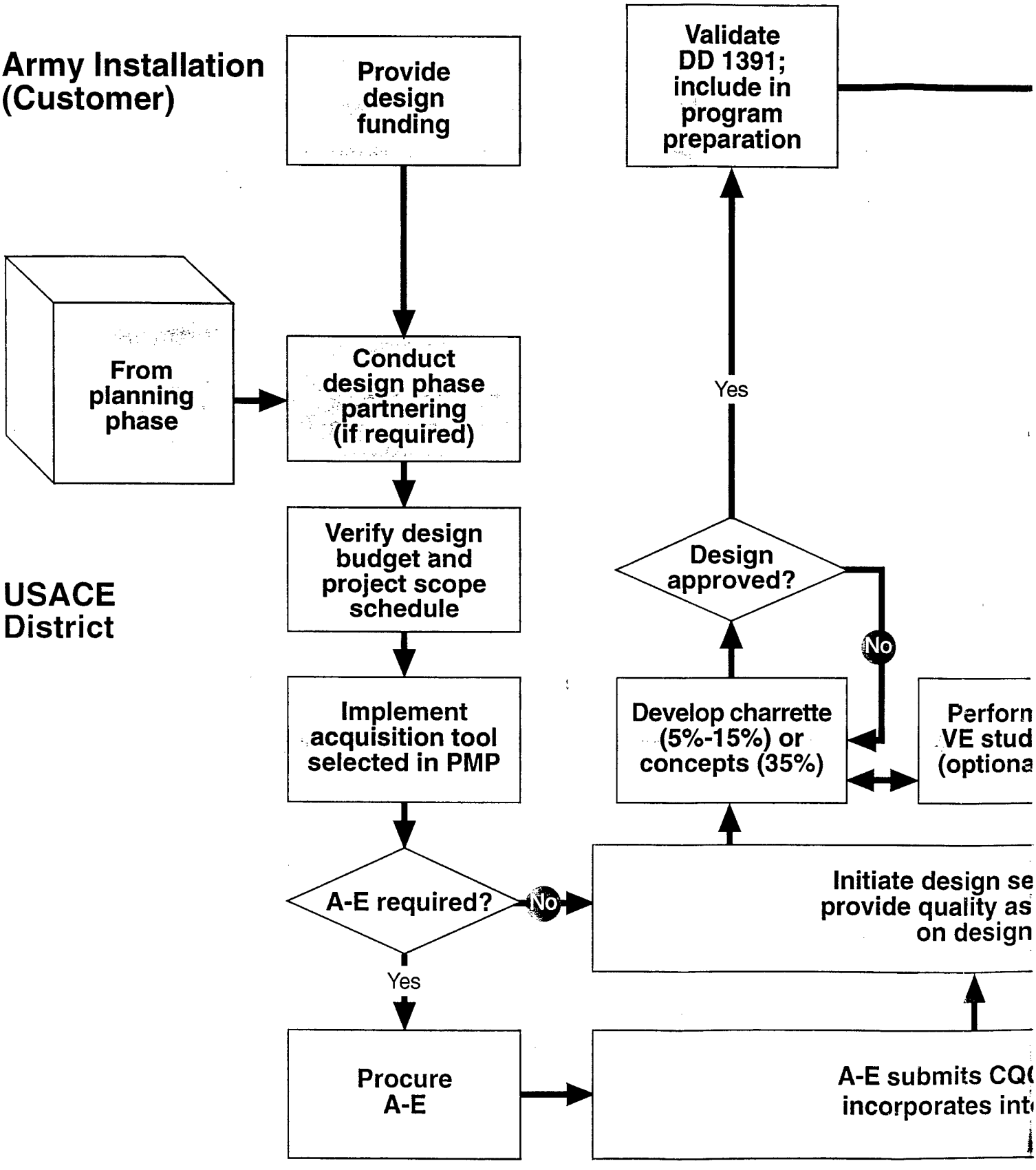

) 1391
Present project to RPPB
Approved?
No
Defer or cancel project
Yes
Submit to MACOM for consideration
Revise DD 1391
Develop prioritized construction list
Certify project
Review project tech, standards cost engineering
No
Acceptable?
Yes
Prepare DD 1391 "books"
Annual CRRC construction procurement request review
MACOM presents project to annual DA PRB
No
Project accepted?
Yes
Authorize code 2 or 3 design
To design phase

Figure A.2 Design Phase Management Process



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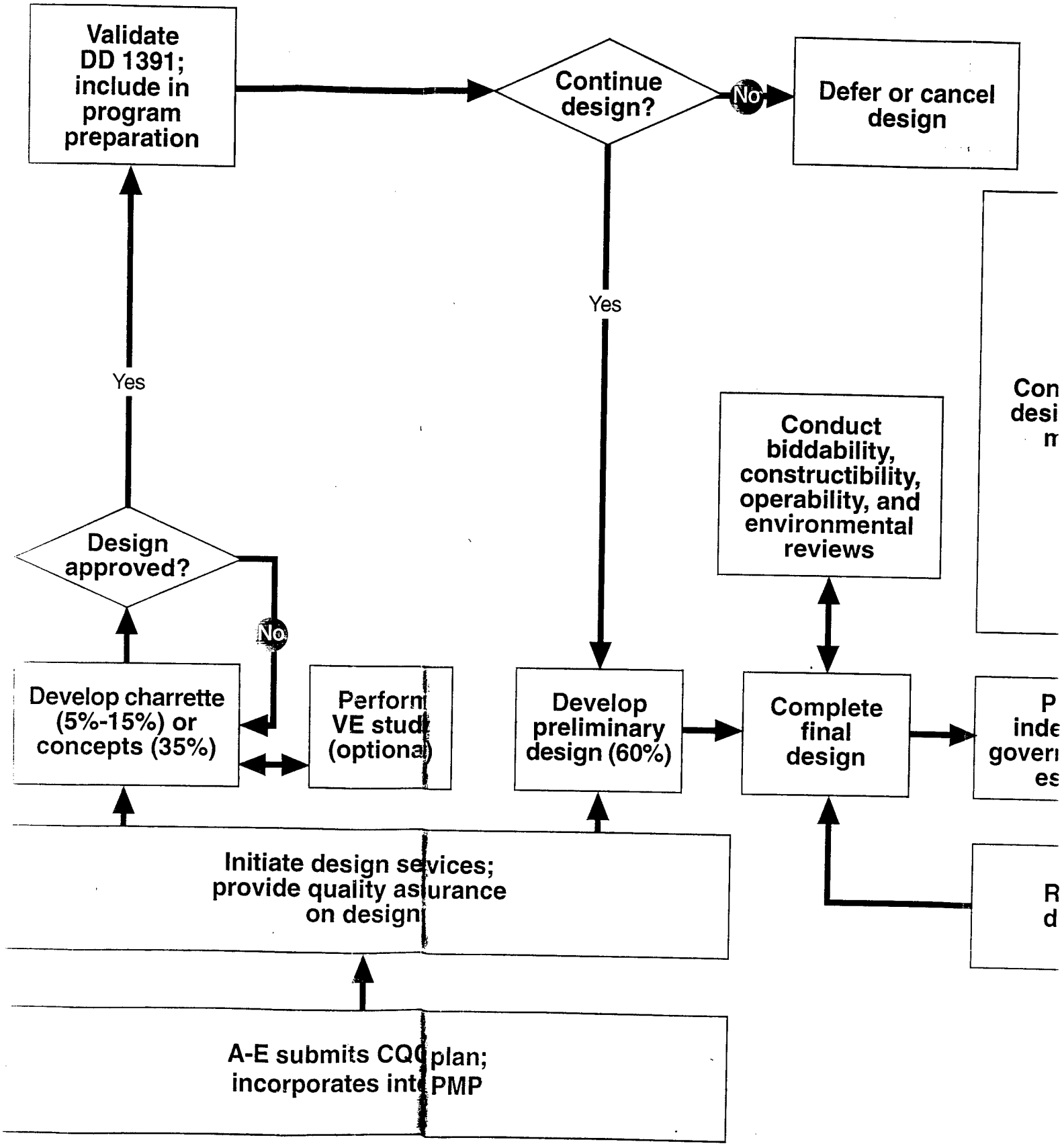


(2)

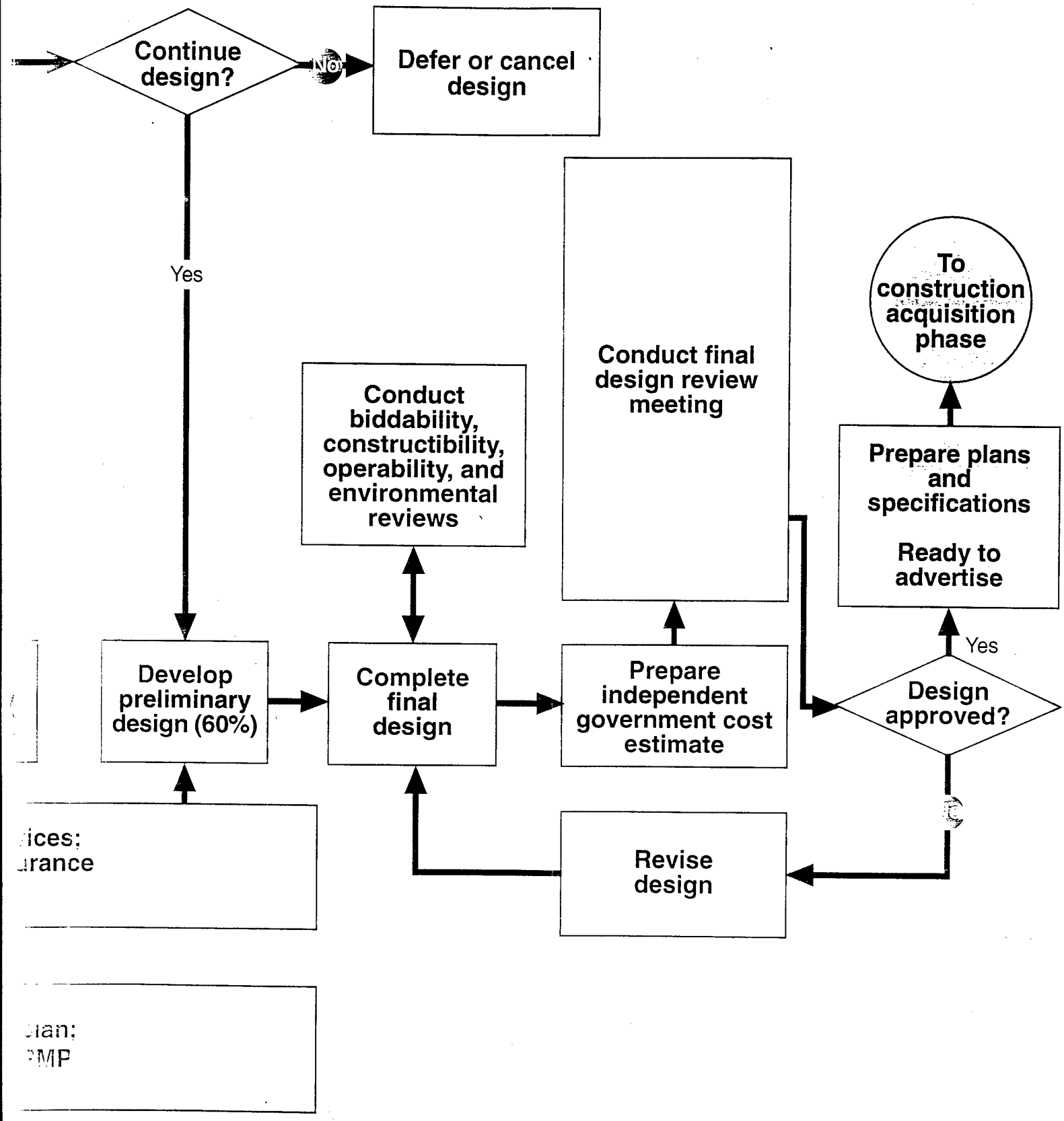
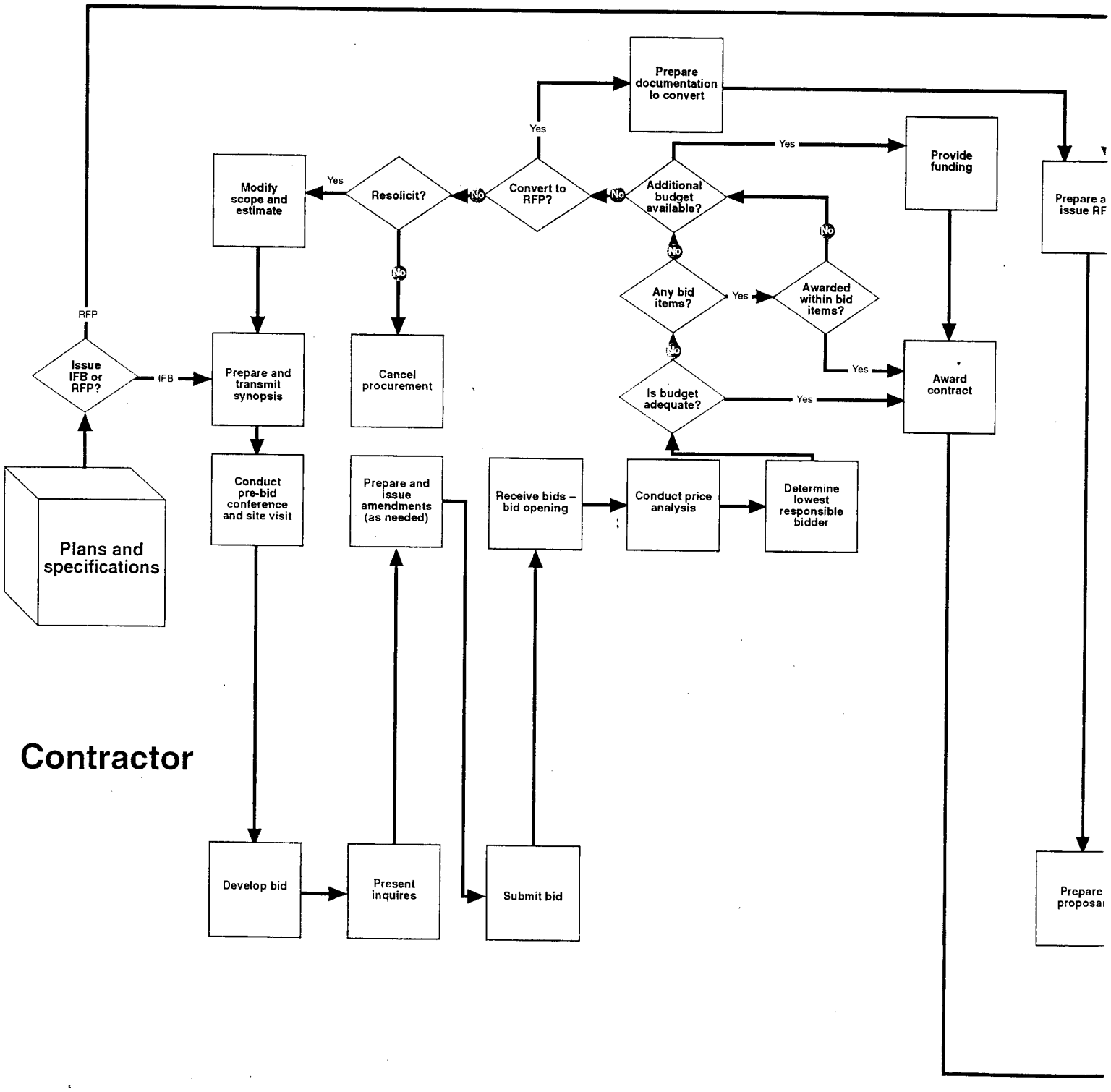

Continue design?
No
Defer or cancel design
Yes
To construction acquisition phase
Conduct final design review meeting
Conduct biddability, constructibility, operability, and environmental reviews
Prepare plans and specifications
Ready to advertise
Develop preliminary design (60%)
Complete final design
Prepare independent government cost estimate
Yes
Design approved?
ices;
urance
Revise design
ian;
PMP

Figure A.3 Construction Acquisition Phase



(1)

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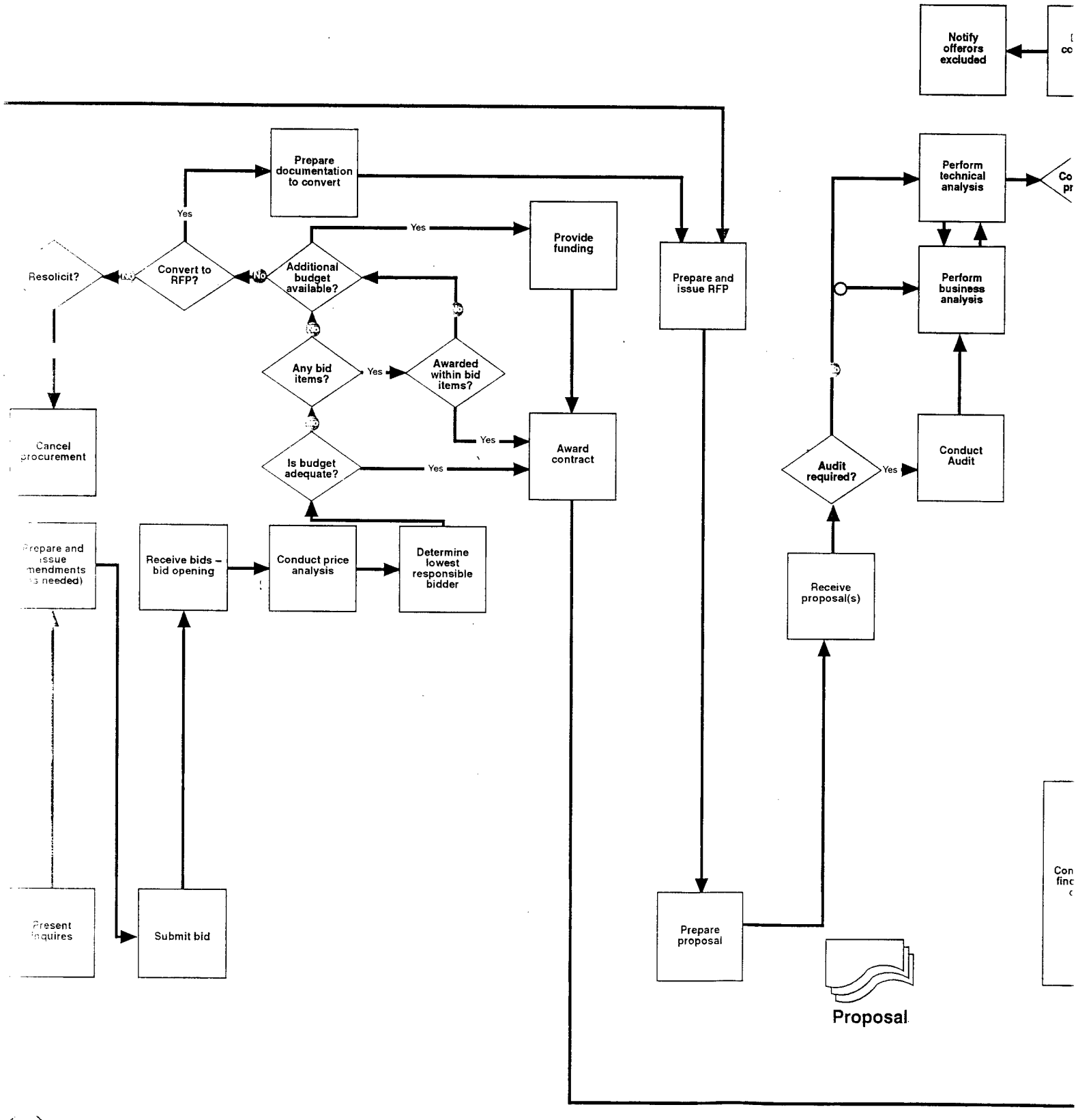


(2)

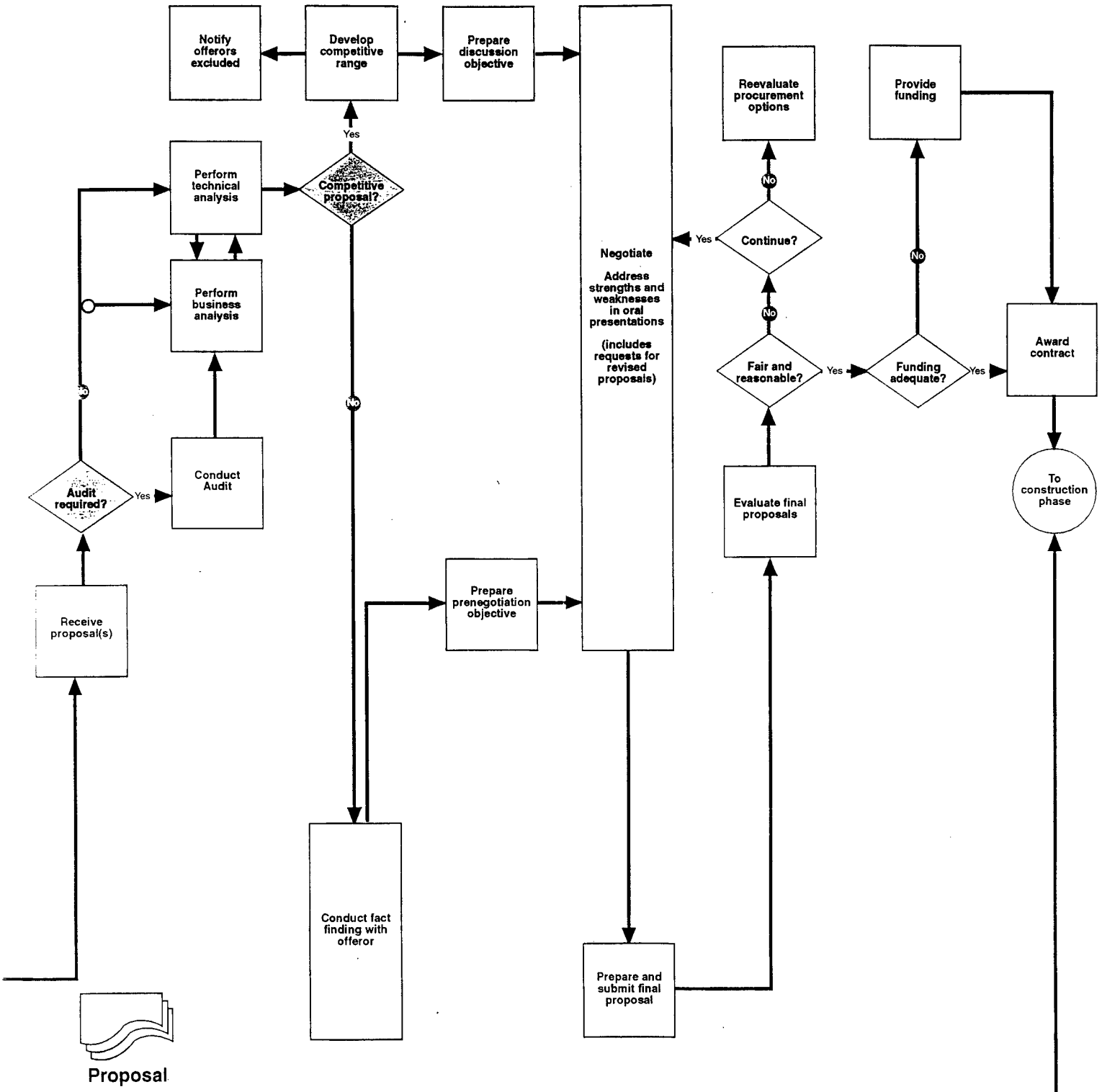
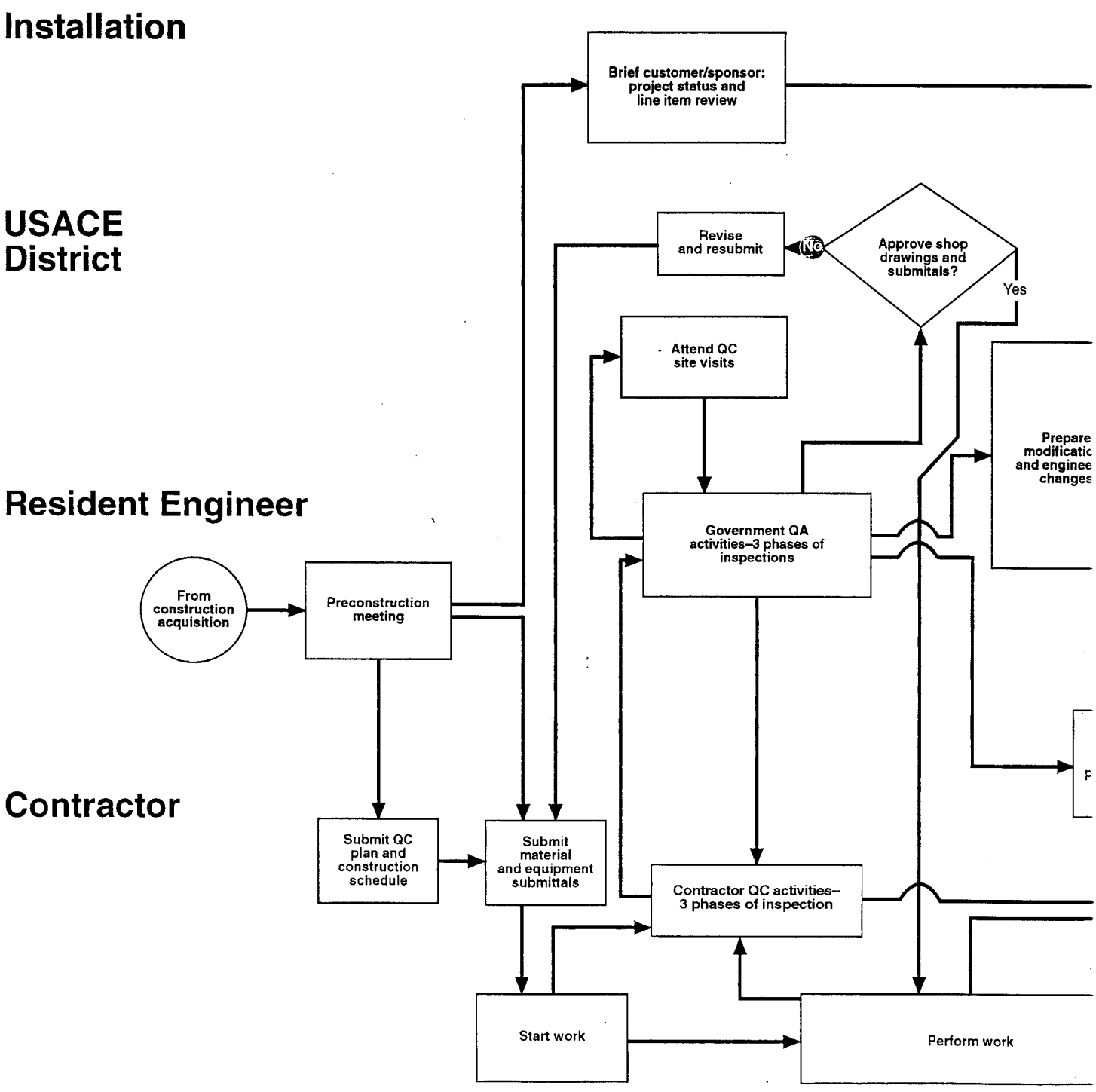
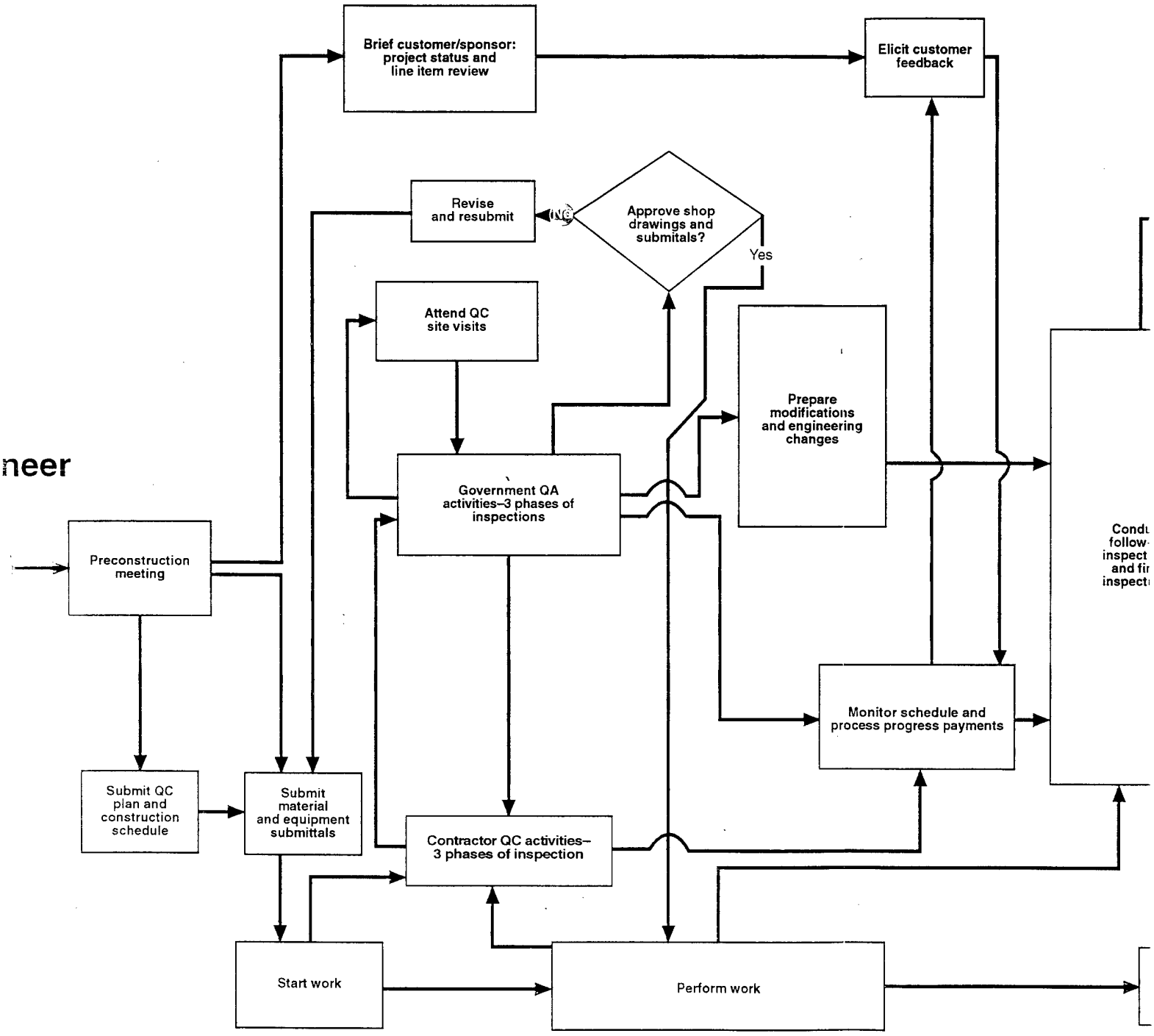

Notify offerors excluded
Develop competitive range
Prepare discussion objective
Yes
Perform technical analysis
Competitive proposal?
Perform business analysis
No
Audit required?
Yes
Conduct Audit
Receive proposal(s)
Proposal
Conduct fact finding with offeror
Prepare prenegotiation objective
Negotiate
Address strengths and weaknesses in oral presentations
(includes requests for revised proposals)
Prepare and submit final proposal
Evaluate final proposals
Reevaluate procurement options
No
Yes
Continue?
No
Fair and reasonable?
Yes
Provide funding
No
Funding adequate?
Yes
Award contract
To construction phase

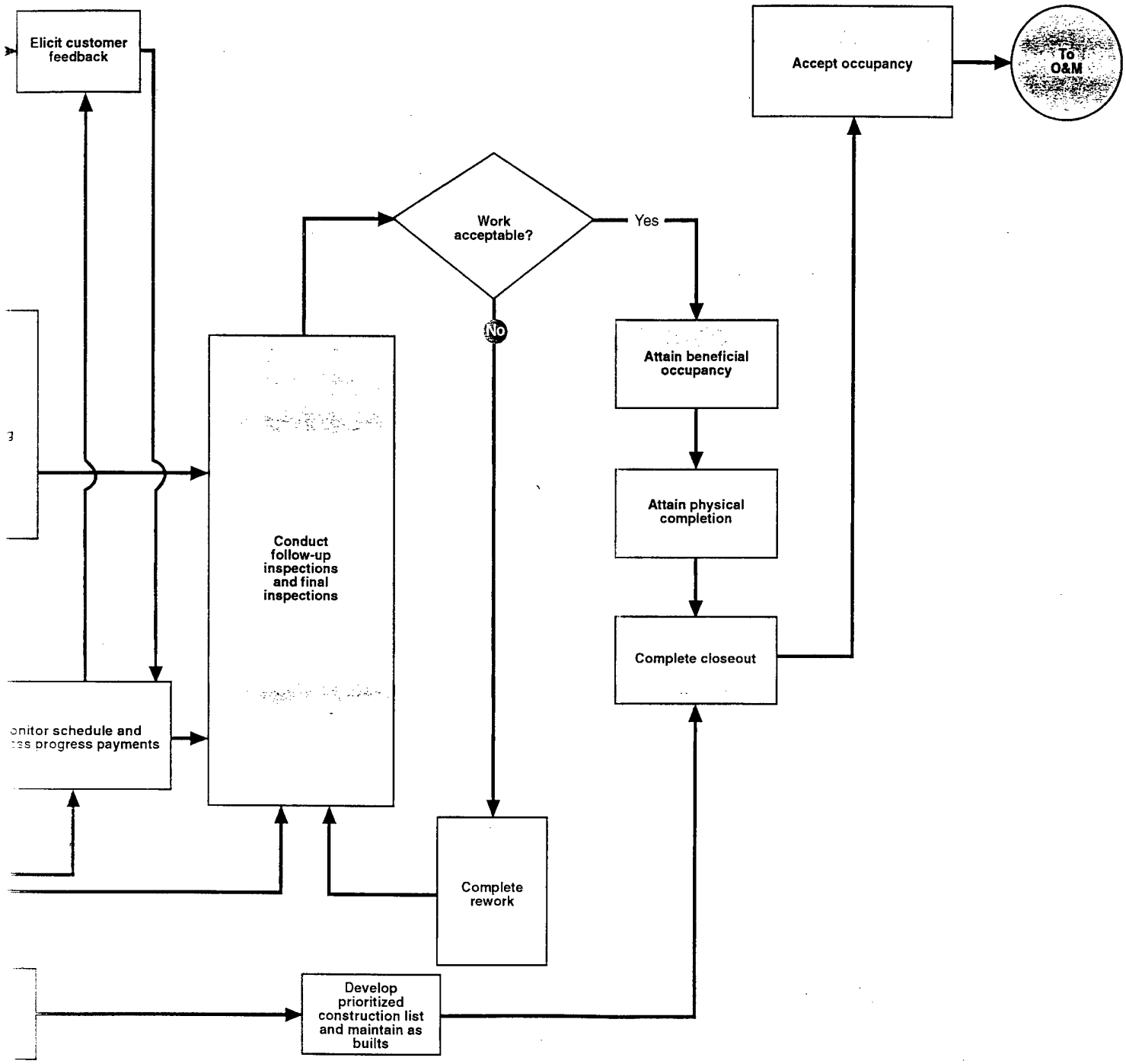
Figure A.4 Construction Phase



(1)

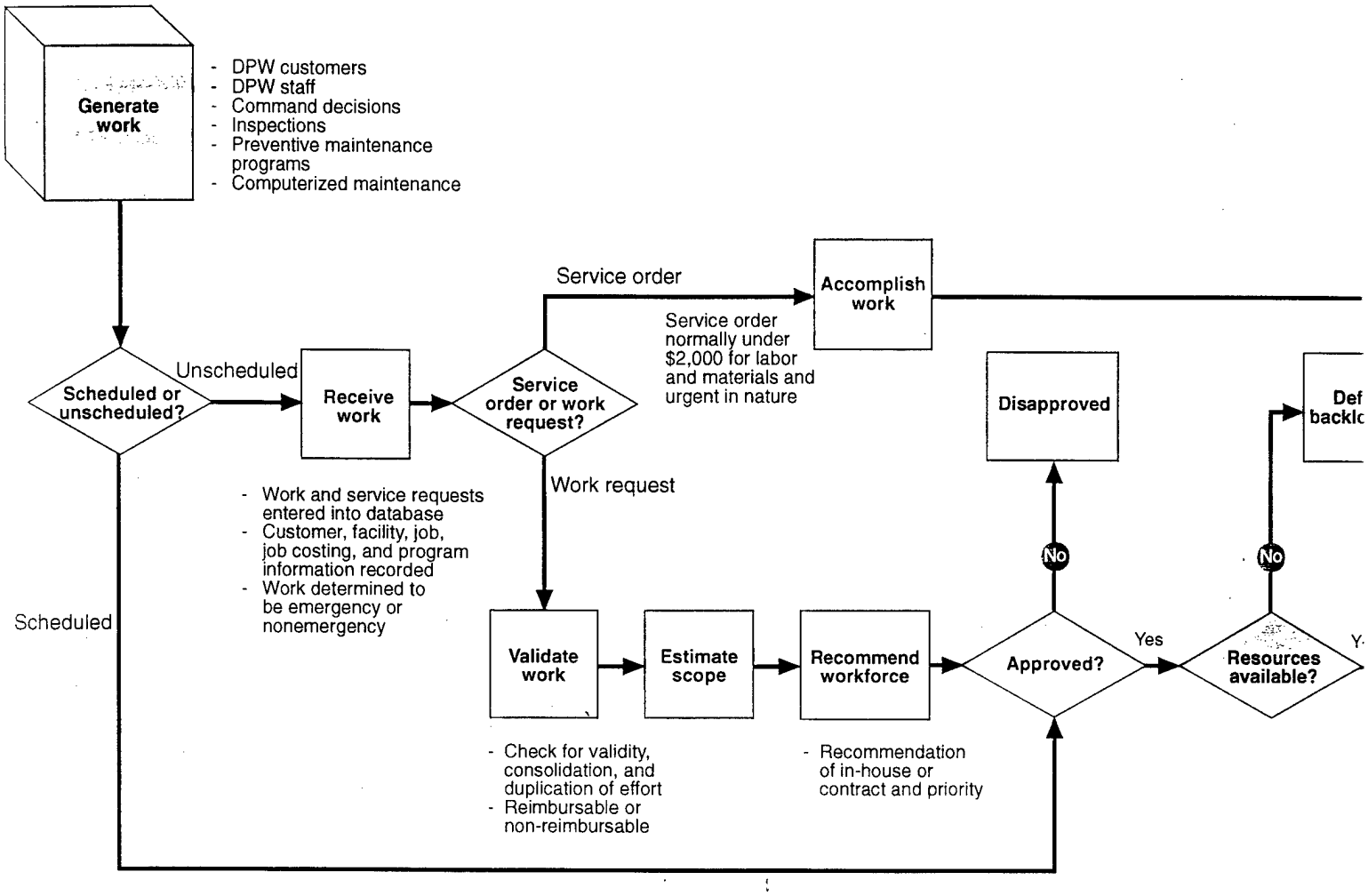
Construction Phase




Elicit customer feedback
Accept occupancy
To O&M
Work acceptable?
Yes
No
Attain beneficial occupancy
Attain physical completion
Complete closeout
Conduct follow-up inspections and final inspections
onitor schedule and ess progress payments
Complete rework
Develop prioritized construction list and maintain as builts

(3)

Figure A.5 Operations and Maintenance Phase



Contractor

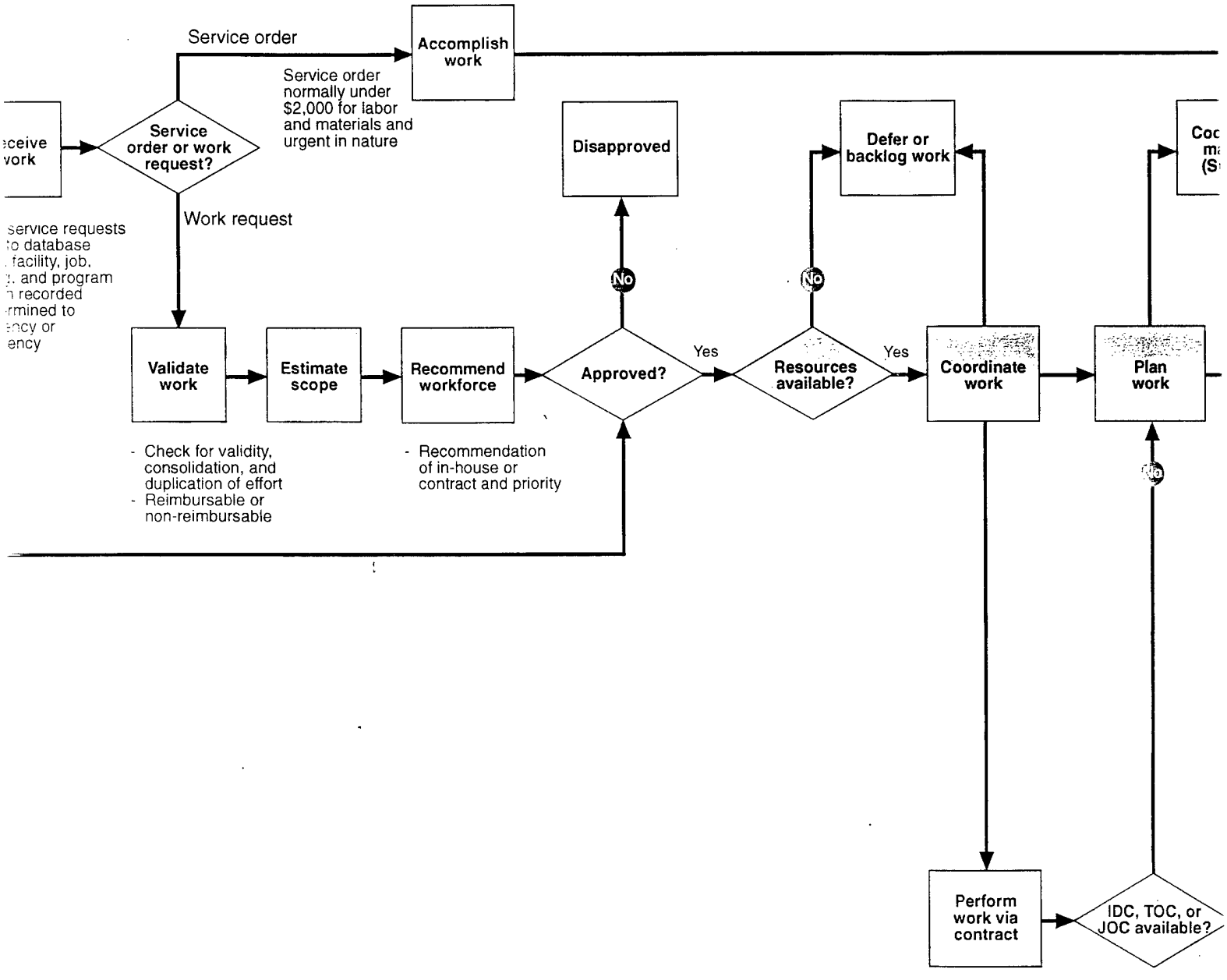
Operations and Maintenance Phase

ers

cisions

aintenance

l maintenance



(2)

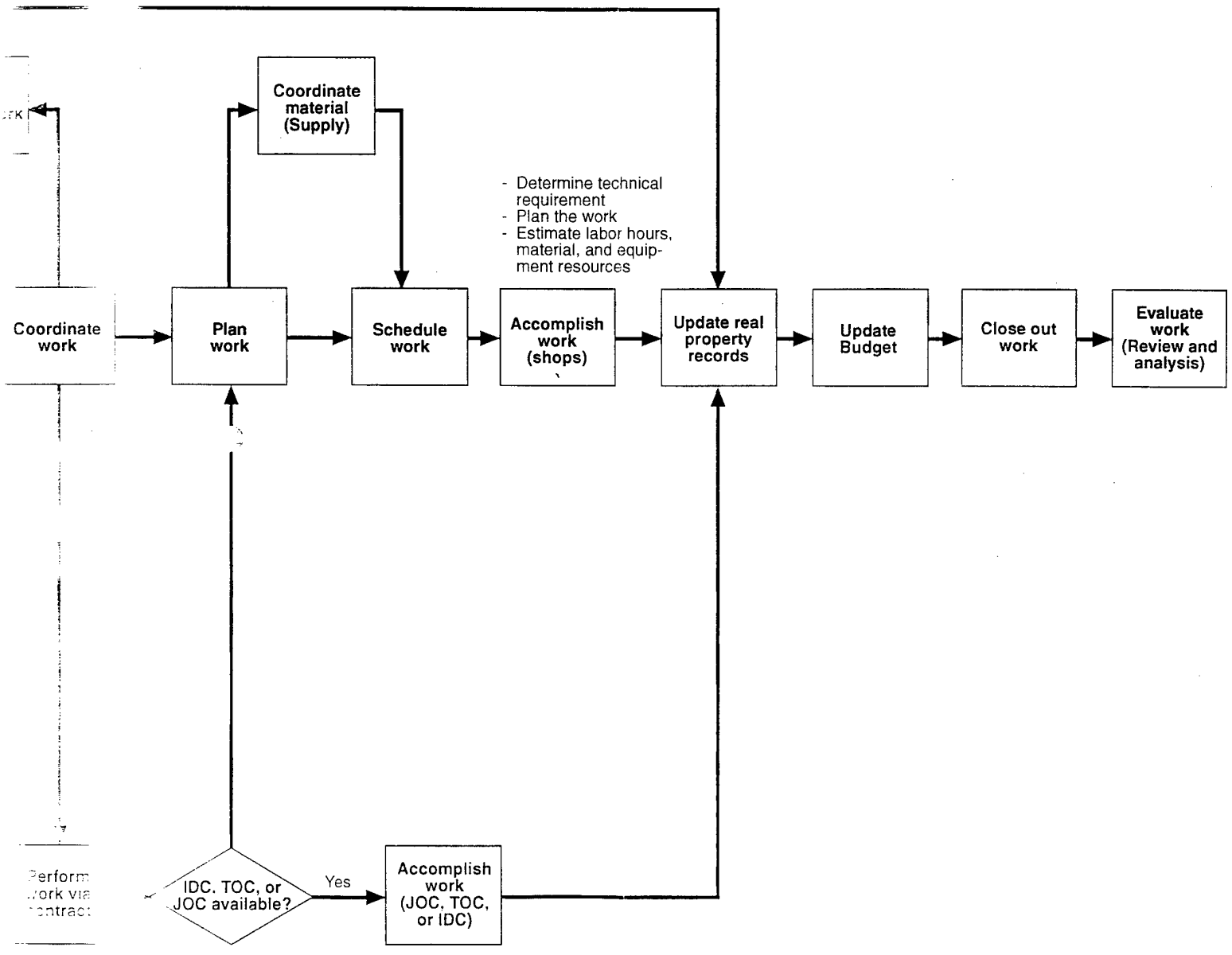
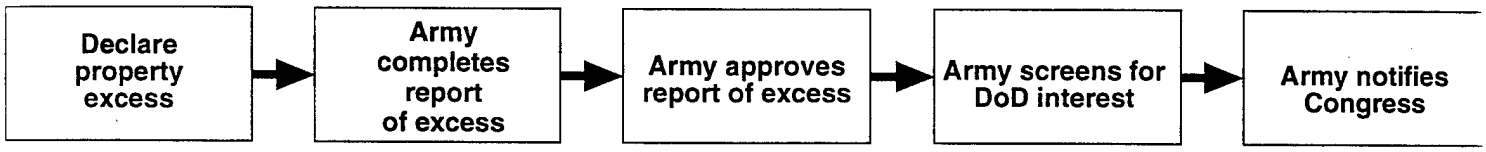
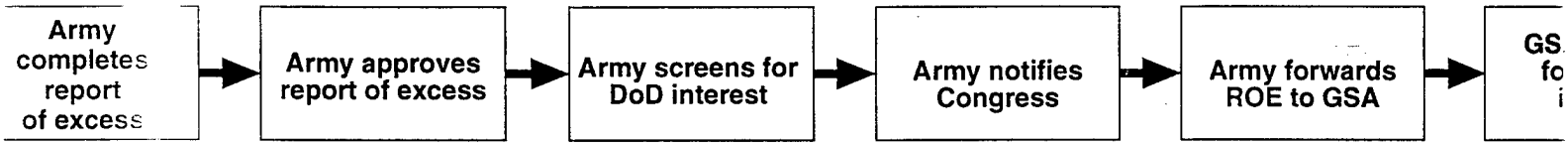
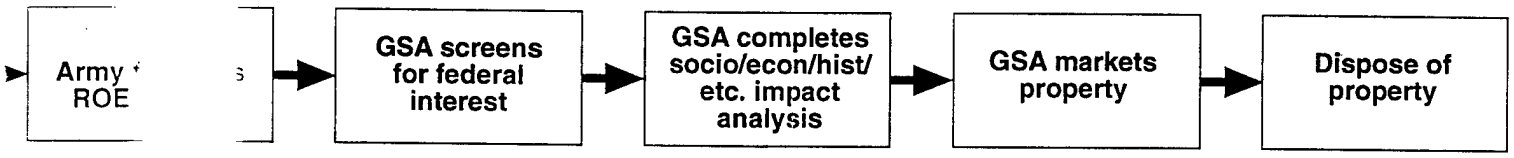

Coordinate material (Supply)
- Determine technical requirement
- Plan the work
- Estimate labor hours, material, and equipment resources
Coordinate work
Plan work
Schedule work
Accomplish work (shops)
Update real property records
Update Budget
Close out work
Evaluate work (Review and analysis)
IDC, TOC, or JOC available?
Yes
Accomplish work (JOC, TOC, or IDC)

Figure A.6 Disposal Overview



Disposal Overview




Army
ROE
GSA screens for federal interest
GSA completes socio/econ/hist/ etc. impact analysis
GSA markets property
Dispose of property

Appendix B
Private-Sector Process

The private-sector facility acquisition and property maintenance process is driven by corporate-level goals and objectives that are part of a corporate strategic plan. Part of the strategic plan is to identify the expected use of a proposed facility and the duration of expected use.

The policy-driven objectives can differ for the different types of organizations acquiring facilities:

- Large corporations, such as Microsoft, that build and maintain facilities for use by their employees and for the production of their products. These organizations, as they assess the need for a facility, concurrently determine the length of expected use. For example, a manufacturing facility in a high tech firm may be expected to have a relatively short useful life. In some instances, these firms may prefer to lease rather than own their facilities to minimize their facility investment and focus capital availability on their core business. Others view owned facilities as valuable assets that strengthen their financial position.

- Organizations that construct and maintain facilities that form the corporate core business, such as hotel and nursing home chains. The duration of expected use of the facility is also part of their strategic corporate plan.

- Organizations, such as Trammel Crow, that build and/or manage buildings for their clients. Information on the intended use and duration of use for such facilities is typically provided to the management organizations by their clients.

Corporate policies and resulting objectives can vary. For example, a hotel chain's primary strategic objective might be to gain a higher market share. A management firm's primary objective might be to gain the highest rate of return on its investment. The return on investment objective may not be consistent with maximizing market share. That is, some investments may increase market share, but the projected rate of return could be below the corporate minimum acceptable rate of return.

Although the specific objectives of private-sector organizations may differ, the basic elements of the private-sector facilities process are similar. Figure B-1 is a summary flow of key process elements.

PLANNING PROCESS

The private-sector planning process typically has a long planning horizon (5 or more years). Given the length of this process, the planning phase focuses on two critical, related analyses that require continuous revision to incorporate changes in local and national economic conditions that affect market demand and costs:

- Market studies
- Financial analysis.

Firms that require new facilities first determine the anticipated demand for their products. Usually, the determine demand by geographic area, but for some organizations, such as IBM or Microsoft, global demand may be more appropriate. A hotel chain first roughly estimates what markets have unmet demand for lodging in their specific submarkets (such as for expensive business-oriented full-service hotels or economy priced motels). Once potential locations are selected, a preliminary financial analysis is undertaken. This is a crucial element of the process because identifying demand does not necessarily demonstrate that a project is financially viable. For example, there may be demand for office space in a particular market, but leases for a new building may not generate sufficient revenue to be profitable. The initial financial review, typically based on historical data, is intended to estimate whether or not a new facility, given historical average costs of design, construction, O&M costs, and periodic facility rehabilitation, could generate a reasonable rate of return. These rough analyses are aimed at identifying a small number of potential projects that deserve further scrutiny. These data are typically provided to a committee that includes representatives from both marketing and financial divisions of an organization. At this phase, some projects are deleted, others given an initial go-ahead; a development team is then assigned to each potential project. Potential building sites associated with each potential project are identified and evaluated, and the anticipated cost of these sites is included in the financial analysis. Typically, one or two sites with the most potential are selected, and work is initiated to determine permit, zoning, and other land use requirements or restrictions. Test borings and environmental site reviews may also be undertaken to determine the suitability of the highest priority site. Other information necessary to facilitate the design process is also collected.

A comprehensive market analysis usually follows initial site selection. This market analysis updates the initial work and obtains, where appropriate, financial and market data on competitors. In addition, the level of demand and expected revenue flows based on the anticipated demand, such as from rents, leases, and potential property sales, are projected. The financial analysis is updated from data provided by the market analysis and site-specific cost data. A preliminary time line is prepared indicating key milestones and an anticipated project completion date assuming that the project receives final approval.

Capital to fund a project is a part of the financial analysis for organizations that do not use internal financing sources. Some hotel chains, for example, depend on financing by local investors to construct a new hotel or motel. Potential investors are contacted when project costs can be reasonably estimated. These potential investors, including financial institutions, typically have their own financial advisors who independently evaluate the economic viability of the project. At times, this external review can delay project construction.

DESIGN

The planning process has a direct impact on design. The current approach to design is to build facilities that can provide maximum flexibility. This approach is in response to rapidly changing technologies and increasing global competition. Some corporations prefer facilities that are essentially basic design shells with interiors that can be easily modified over more traditional facilities designed for long-term use. The traditional design has the benefit of durability, but modifications necessitated by technological or other changes are costly.

The conceptual design phase usually begins when information on a specific site is available and an updated financial analysis indicates the project will have an acceptable rate of return. Detailed design is not initiated until the project receives final approval. The full design is frequently not completed until after construction begins. Interior plans, for example, are often not completed until the building frame is completed. This concurrent design-build approach is aimed at minimizing any construction delay associated with final design. Time is of the essence since, typically, considerable capital may be idle during construction. In addition, market conditions could change while waiting for the design to be completed. Delay increases uncertainty and can reduce project profitability. This is a major reason why design-build is favored by many private organizations.

CONSTRUCTION

The tendency in the private sector is to follow the design-build approach, with the same organization both designing and building a facility. Two factors account for this tendency. As already noted, the process is faster than the traditional design-bid-select a contractor approach. Time is a crucial factor in the private sector. A second factor is the tendency for an organization to select the same construction contractor for its projects as a result of favorable experience with the organization. Unlike the public sector, one does not have to demonstrate that the selected contractor is the lowest cost or highest value prior to the selection of a contractor. These close working relationships reduce potential delay due to disputes or, in some instances, litigation.

The limitations of the design-build approach are that the cost may be higher than when seeking the lowest bid and that the designers may cut corners to reduce construction costs and thus increase their profit margin for the organization.

Notwithstanding these potential problems, a substantial number of private projects are design-build.

OPERATIONS AND MAINTENANCE

The private-sector O&M process typically has three key elements: early planning for funding, outsourcing, and preventive maintenance.

Funding

Adequate financial management was a crucial element in maintenance cited by all private managers we interviewed. As part of this financial management process, O&M costs are carefully calculated as an integral element of the financial analysis in the planning phase, and these cost data are updated during the design and construction phases. Before construction is completed, a detailed budget is prepared that includes preventive maintenance once construction is completed. A final determination is usually made as to whether or not to outsource O&M before construction begins.

In some instances, the lending institution (typically a bank or insurance company) will require that the developer retain a maintenance reserve fund that is held in escrow to ensure continuous funding.

Outsourcing of Maintenance and Repair

Most private firms outsource maintenance completely. The outsourcing firm "owns" the process and will perform maintenance and repair at predetermined service levels and predetermined fees. Because fees are negotiated at the beginning of the contract, the contractor has a strong economic incentive to be efficient and thus profit from the agreement. A tenant that wants higher service levels than provided for in the agreement must negotiate for them. The private-sector efficiency is gained, in part, by the use of semi-skilled labor for most routine maintenance tasks. Higher skilled technical workers are used only as needed for more complex tasks.

Some private firms maintain their own maintenance staffs, particularly when they own or manage large buildings, with most of their maintenance employees in the semi-skilled categories. Skills of these workers are improved and maintained by scheduled worker training. A building maintenance manager is given the overall responsibility to maintain the facility and typically has the authority to select the maintenance crews. To reduce costs, all but the most complex maintenance problems are the responsibility of in-house staff. These complex tasks are contracted out to vendors using ID/IQ contracts.

Preventive Maintenance

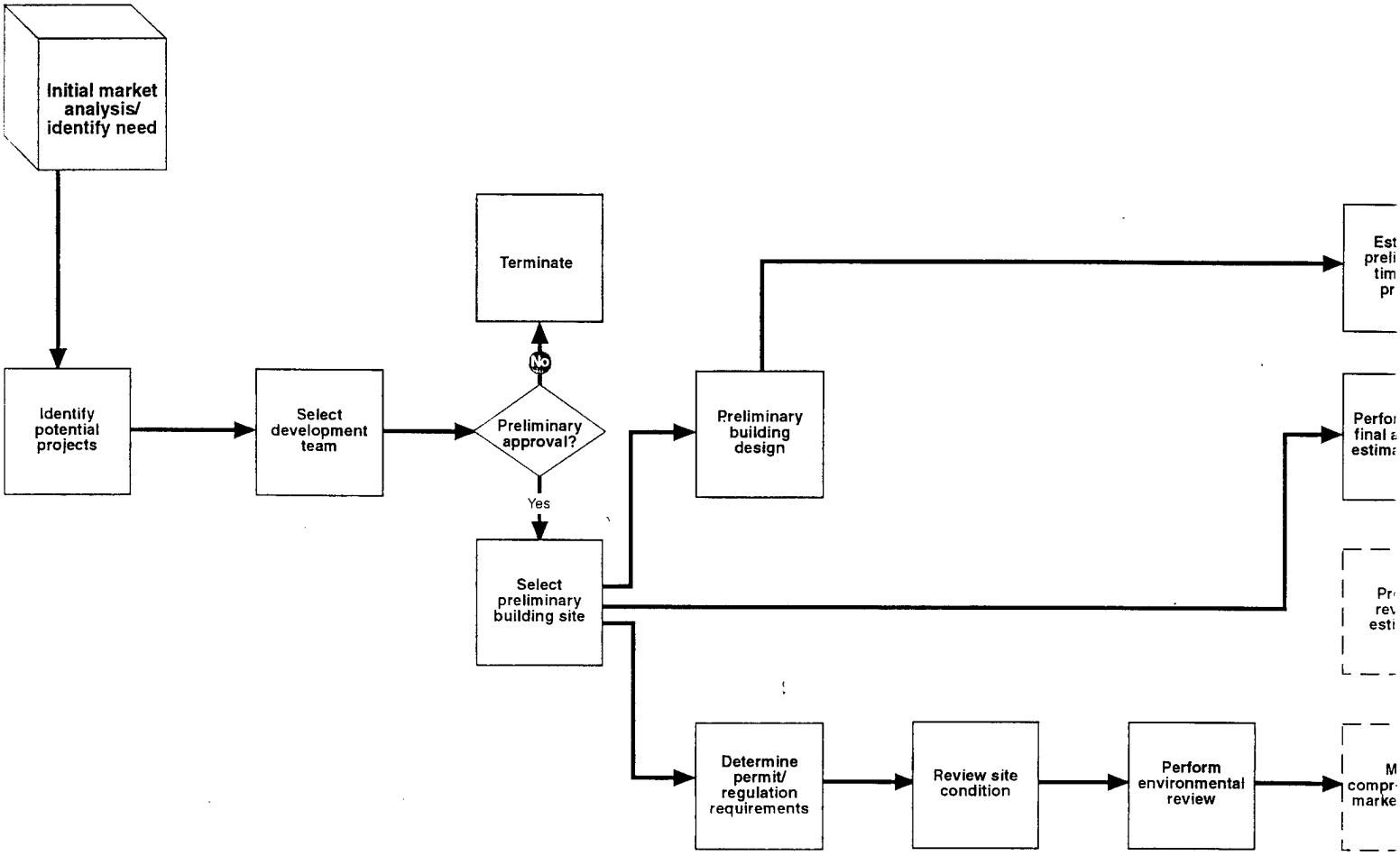
Preventive maintenance policies are an essential element of the private-sector process. Without exception, the policy is that it is necessary to fund preventive maintenance to maintain property values. If sufficient funds for preventive maintenance could not be budgeted at the planning phase, the proposed facility would not be approved for construction. Preventive maintenance is viewed as an economic requirement to maximize the value of the real estate and to reduce long-term maintenance costs.

In the private sector, the design specifications usually identify a particular brand and model number. Typically, these specifications are based on favorable past experience with the manufacturer (or distributor) and the quality of the specific product. Although this practice tends to make it difficult for a new product to compete, it does provide a level of quality control. The manufacturer tends to fully back the product warranties because it could lose future business if it does not honor these commitments.

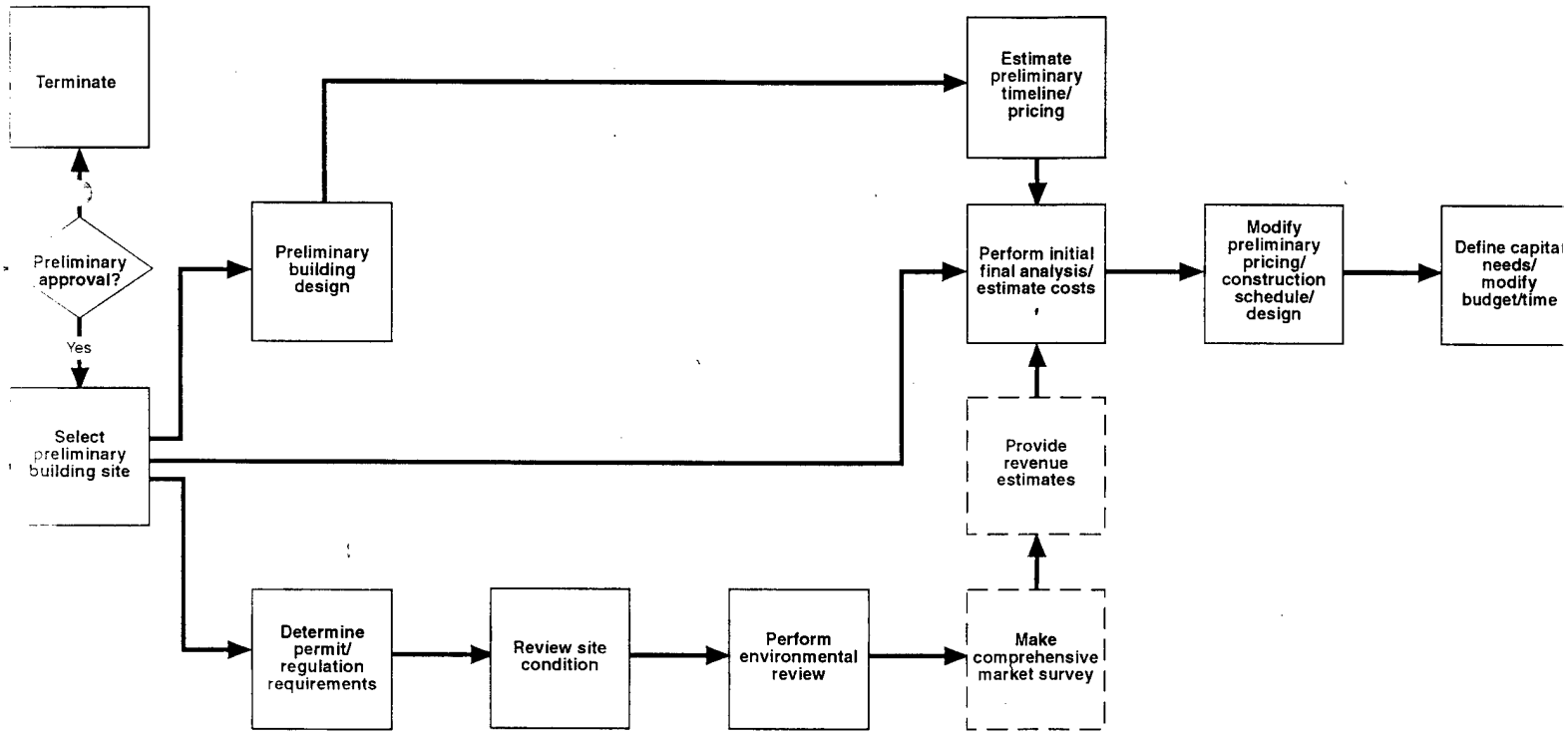
REINVESTMENT AND DISPOSAL

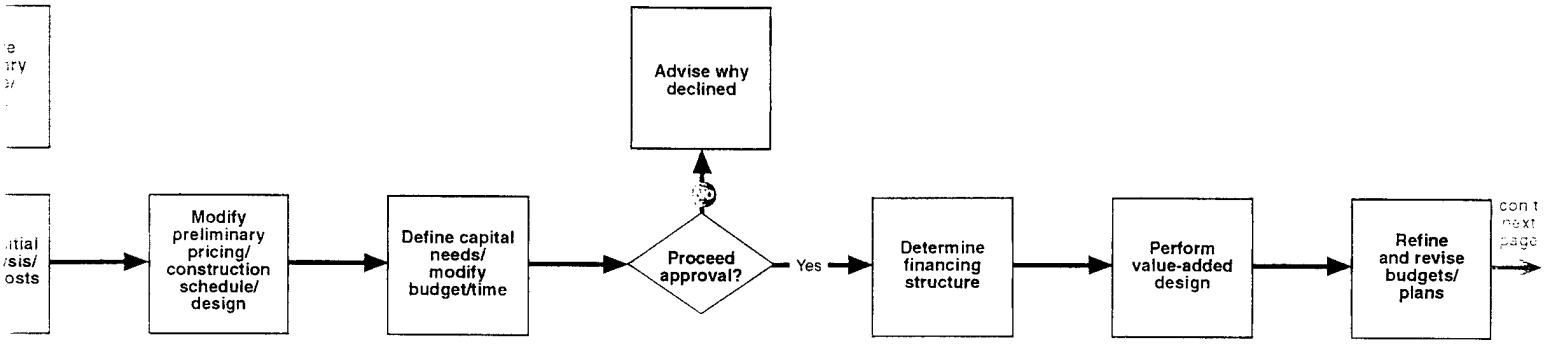
The timing of facility disposal typically is based strictly on financial reviews. Periodically, an organization determines whether or not to rehabilitate its aging facilities. The costs of rehabilitation are compared to subsequent benefits from the investment (higher rents, more productive work force). The alternative to reinvestment is to dispose of the property (usually in the form of a sale). A building may be sold when fully tax depreciated, thus reducing its profitability, or when the return on the original investment falls below the expected level. The need for capital can also trigger a decision to sell a property. Certain organizations (such as shopping center developers) usually sell a center when it is fully leased because the value of the property is based on cash flows from such leases and not the cost of the structure. In some instances, a decision is made to tear down an existing obsolete building because the value of land exceeds the value of the building.

Figure B.1 Private-Sector Flow Chart



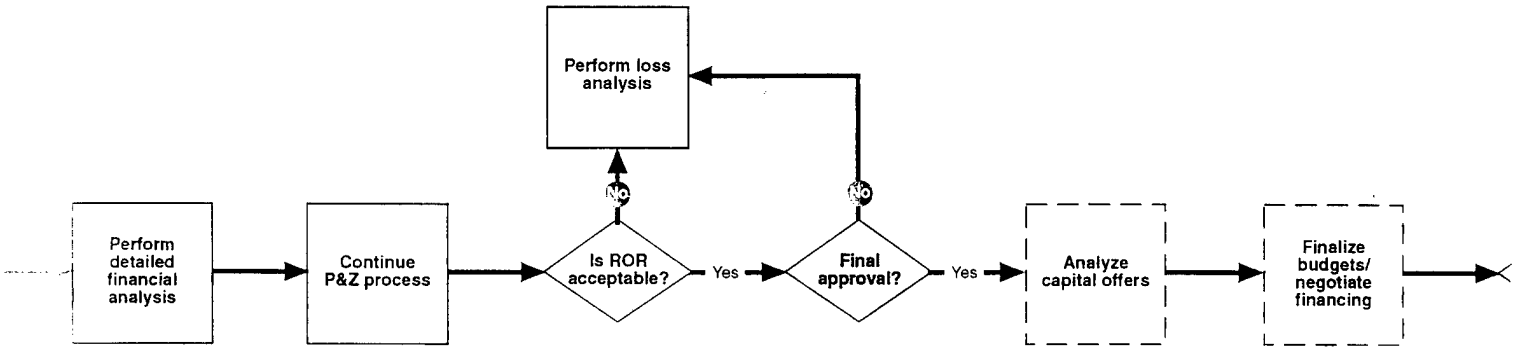
ate-Sector Flow Chart




Modify preliminary pricing/ construction schedule/ design
Define capital needs/ modify budget/time
Proceed approval?
Yes
Advise why declined
Determine financing structure
Perform value-added design
Refine and revise budgets/ plans
cont next page

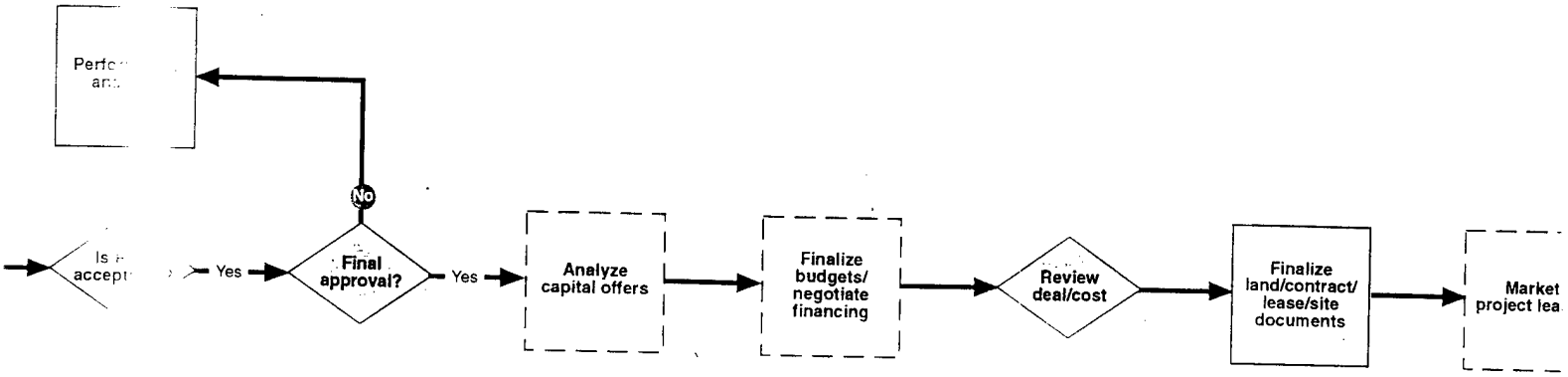
(3)

Figure B.1 Private-Sector Flow Chart (con't)

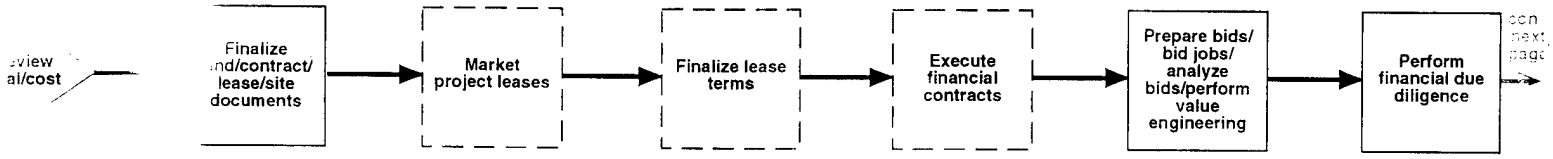


(1)

ate- ector Flow Chart (con't)

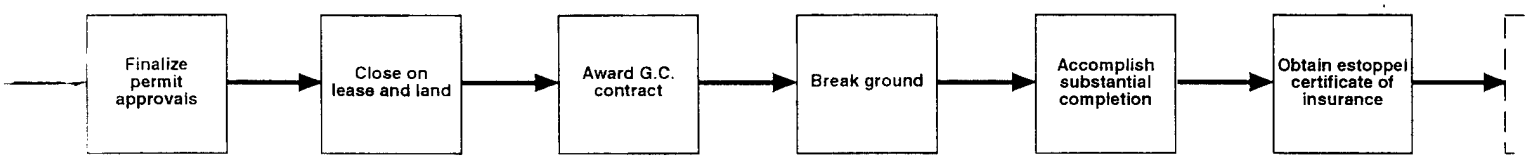


(2.)

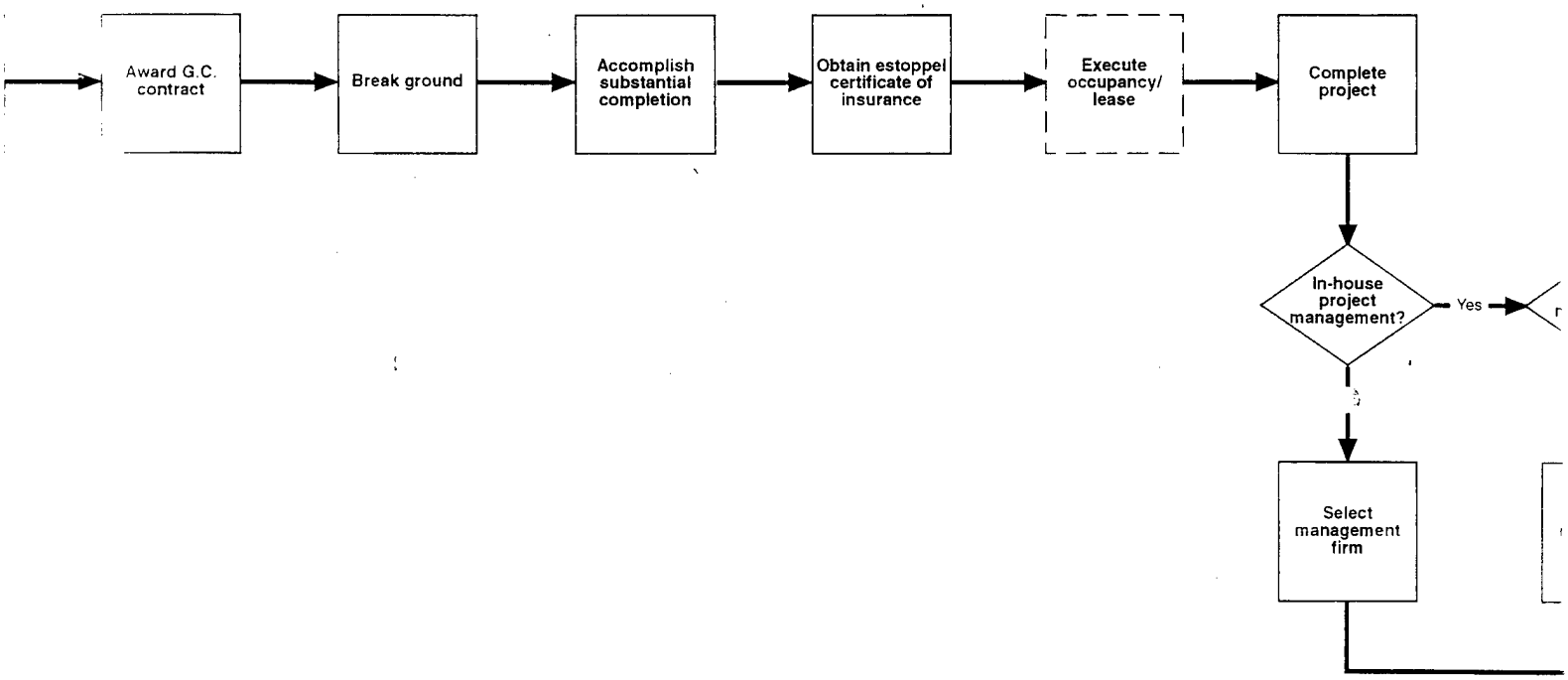

eview
al/cost
Finalize
nd/contract/
lease/site
documents
Market
project leases
Finalize lease
terms
Execute
financial
contracts
Prepare bids/
bid jobs/
analyze
bids/perform
value
engineering
Perform
financial due
diligence

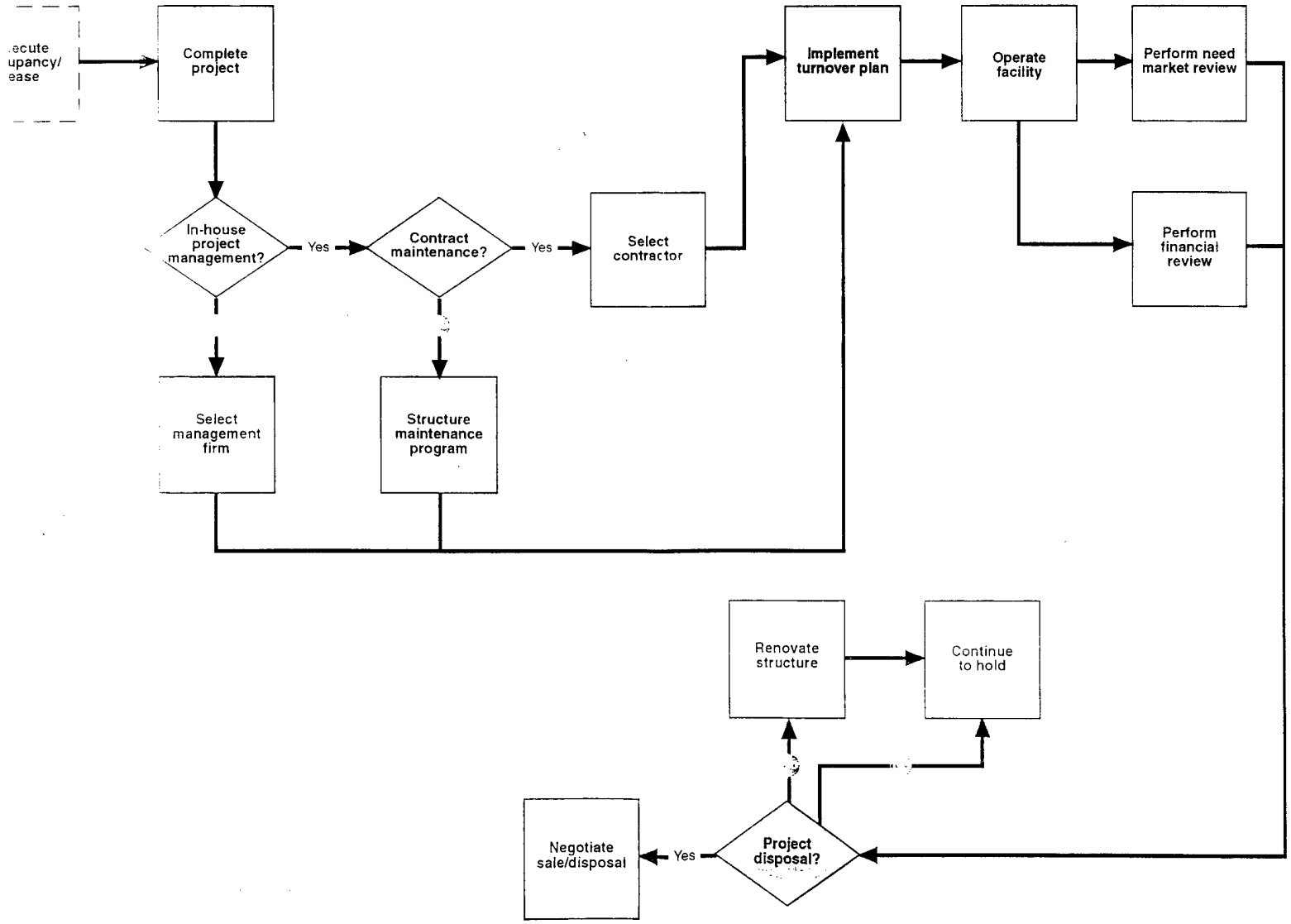
(3)

Figure B.1 Private-Sector Flow Chart (con't)



vate-Sector Flow Chart (con't)




ecute
upancy/
ease
Complete project
In-house project management?
Yes
Contract maintenance?
Yes
Select contractor
Implement turnover plan
Operate facility
Perform need market review
Perform financial review
Select management firm
Structure maintenance program
Renovate structure
Continue to hold
Negotiate sale/disposal
Yes
Project disposal?

(3)

Appendix C
User Satisfaction Survey

INTRODUCTION

Our task to study the life cycle of Army facilities included an assessment of quality. This appendix addresses a subjective component of quality—namely, user satisfaction. To assess user satisfaction, we conducted a survey that focused on measuring eight factors of quality from the user's perspective. Table C-1 lists the eight factors and their attributes.

Table C-1. Quality Factors and Attributes

Factors	Attributes
Performance	Primary operating characteristic of the facility in meeting needs.
Features	"Bells and whistles" that supplement the facility's basic functions.
Reliability	Probability that the facility and the installed equipment will operate properly within a given period.
Conformance	Extent or degree to which a facility meets expected or established standards.
Durability	Life of the facility and its installed equipment.
Serviceability	Speed of repair and the competence and courtesy of the repair crew.
Aesthetics	Way a facility's interior and exterior looks, feels, sounds or smells.
Other perceptions	Factors, such as image, culture, and reputation of the Army, that are reflected in the facilities.

APPROACH

We held focus groups at the seven installations that we visited: Forts Bragg, Drum, Hood, Lewis, Meade, Richardson, and Sam Houston. The focus groups mostly consisted of Corps of Engineers staff, installation public works personnel, junior and senior enlisted members, civil servants, and family members.

We asked participants to rate their facilities according to the eight quality factors. On each survey, the users identified their facilities as family housing, barracks, administrative buildings, or gymnasiums. (Annex C-1 contains a copy of the focus group questionnaire.) Most users indicated more than one type of facility. Altogether, the focus groups submitted 72 questionnaires.

At each installation, the focus groups openly discussed their facilities for 1 hour and then completed the questionnaire. Each survey consisted of eight questions

that addressed a different quality factor. Table C-2 summarizes the eight different factors of quality and their corresponding question. To rate the factor, each question was preceded by the question: "To what extent do you agree with this statement?"

Table C-2. Summary of Survey Questions

Factor	Question
Performance	The facility I use performs to my expectations.
Features	The facility I use has the features I would have expected.
Reliability	The facility I use is reliable.
Conformance	The facility I use conforms to Army standards.
Durability	The facility I use is adequately durable.
Serviceability	I'm pleased with the maintenance and repair service I receive at the facility I use.
Aesthetics	The facility I use is aesthetically pleasing.
Other perceptions	Working or living in my facility makes me feel proud to be part of the Army family

We asked users to rate their satisfaction with their facility using a five-point rating scale ranging from "strongly disagree" to "strongly agree." Table C-3 shows the possible responses to the survey questions and their corresponding rating.

Table C-3. Possible Responses to Survey Questions

Possible responses	Rating
Strongly disagree	-2
Mildly disagree	-1
Indifferent	0
Mildly agree	+1
Strongly agree	+2

After collecting the surveys, we grouped the responses by quality factor regardless of facility type or installation. Next, we translated each response into a numerical value ranging from -2 to +2, in accordance with Table C-3. Then, we created a distribution of responses and calculated the median response for each quality factor. Annex C-2 contains a distribution chart for each quality factor and the median response.

The questionnaire also provided a section under each question for respondents to clarify their answers or provide additional comments.

SURVEY RESULTS

Generally, users were satisfied with the overall quality of their facilities in terms of the eight quality factors.[1] Every factor except "other perceptions" received a median response of "mildly agree"; "other perceptions" received a median response of "indifferent."

Typically, users' comments identified the facilities they were happy with and the ones they were not. Mostly, users were happy with new or recently renovated facilities, which tended to be administrative buildings and gymnasiums. Users were unhappy with older, outdated facilities, which tended to be barracks and family housing. Annex C-3 contains the survey respondents' comments.

The following subsections discuss the analysis results for each quality factor. We reiterate the question and attribute of quality for each factor at the beginning of each section.

Performance

***Question**: To what extent do you agree with this statement? The facility I use performs to my expectations.*

***Attribute**: The primary operating characteristic of the facility in meeting needs.*

The median response for facility performance was 1, indicating a mildly positive rating. This can be interpreted as an overall positive level of user satisfaction with the performance of the facilities. In particular, users were pleased with the performance of new or renovated administrative buildings and gymnasiums. However, there were some complaints about the constant malfunctions of heating, ventilation, and air conditioning systems; insufficient electrical systems; and substandard plumbing in the older facilities.

Features

***Question:** To what extent do you agree with this statement? The facility I use has the features I would have expected.*

***Attribute:** The "bells and whistles" that supplement the facility's basic functions.*

The median response for facility features was 1, indicating a mildly positive rating. This can be interpreted as an overall positive level of user satisfaction with the features of the facilities. Users agreed that the facilities they use have the features they expect and need. In particular, users were satisfied with gymnasiums and administrative buildings. They stated that gymnasiums have modern

[1] Our survey results are similar to those of a customer satisfaction survey conducted by the U.S. Army Corps of Engineers in 1999.

state-of-the-art equipment and administrative buildings have controlled temperature and good lighting. However, there were some complaints about the lack of space and storage room in family housing, administrative buildings, and barracks. In addition, comments indicated that administrative buildings needed elevators, better handicapped accessibility, and more parking. One user mentioned that tenants caused some of the damage to the facilities.

Reliability

***Question**: To what extent do you agree with this statement? The facility I use is reliable.*

***Attribute**: The probability that the facility and the installed equipment will operate properly within a given period.*

The median response for facility reliability was 1, indicating a mildly positive rating. Most of the comments indicated constant problems with heating, ventilation, and air conditioning systems, mainly because of the low quality of the equipment installed. Others mentioned that the materials used in their facilities were cheap and not very durable. However, some users felt that their facilities were pretty reliable, in particular the gymnasiums. They said that in gymnasiums, all equipment was in good working condition and appeared to be maintained regularly.

Conformance

***Question**: To what extent do you agree with this statement? The facility I use conforms to Army standards.*

***Attribute:** The extent or degree to which a facility meets expected or established* standards.

The median response for facility conformance was 1, indicating a mildly positive rating. This can be interpreted as an overall positive level of user satisfaction with the conformance of the facilities. For the most part, users agreed that their facilities conform to Army standards. Specially, users indicated that they were satisfied with the standards of new or recently renovated family housing and gymnasiums. One user mentioned that his house exceeded his family's needs. Nevertheless, comments indicated that some users did not know what the current Army standards for facilities are. In addition, there were some complaints about the Army's low standards in older barracks and family housing, sometimes below the standards of military services.

Durability

***Question**: To what extent do you agree with this statement? The facility I use is adequately durable.*

***Attribute**: The life of the facility and its installed equipment.*

The median response of facility durability was 1, indicating a mildly positive rating. Most of the comments indicated constant problems with the heating, ventilation, and air conditioning systems; insufficient electrical systems; and substandard plumbing in all facility types. Some users mentioned that old systems were repaired by "patchwork" and that there was a lack of preventive maintenance in new facilities. Nevertheless, users of new or renovated gymnasiums and administrative building were satisfied with the durability of their facilities.

Serviceability

***Question**: To what extent do you agree with this statement? I'm pleased with the maintenance and repair service I receive at the facility I use.*

***Attribute**: The speed of repair and the competence and courtesy of the repair crew.*

The median response for facility serviceability was 1, indicating a mildly positive rating. This can be interpreted as an overall positive level of user satisfaction with the serviceability of the facilities. In general, users were satisfied with the speed of repairs and the competence and courtesy of the repair crew. Users indicated that the repair crew was friendly and that the repair jobs were done in an efficient, speedy, and timely manner. However, some users commented that although the work performed was efficient, it was only a "quick fix" and that it did not last, because of the low quality of the components used by the Army. Other users added that lower priority repairs had a longer response time than emergency repairs.

Aesthetics

***Question**: To what extent do you agree with this statement? The facility I use is aesthetically pleasing.*

***Attribute**: The way a facility's interior and exterior looks, feels, sounds or smells.*

The median response for facility aesthetics was 1, indicating a mildly positive rating. This can be interpreted as an overall positive level of user satisfaction with the aesthetics of the facilities. Mostly, users were happy with the interior and exterior of their facility. Particularly, users were satisfied with the new or recently renovated administrative buildings. Other users indicted that they were happy with improved landscaping. Nevertheless, some users complained about the

interior and exterior of older family housing and barracks. They indicated that they needed fresh paint and new carpeting.

Other Perceptions

Question: *To what extent do you agree with this statement? Working or living in my facility makes me feel proud to be part of the Army family.*

Attribute*: The factors, such as image, culture and reputation of the Army, that are reflected in the facilities.*

The median response for facility aesthetics was 0, indicating that users are indifferent to factors, such as image, culture, and reputation of the Army, that are reflected in the facilities. Some users were happy to be in family housing because they said that they were living in better quality housing than they could afford off-post. Some users commented that they take much pride in the maintenance and the appearance of their facility, even if it is old. However, some users felt that the Army needs to allocate more funds to the renovation and the improvements of their facilities and that it should use better quality components.

ANNEX C-1. FOCUS GROUP QUESTIONNAIRE

As part of a study we're doing for the Assistant Secretary of the Army for Installations and Environment, we are assessing user satisfaction with the delivery and maintenance of Army facilities. This focus group will help us gather the data we need to make that assessment. Thus, we ask that you answer the questions listed below. Questions 2 through 10 focus on the generally accepted dimensions of quality (each dimension will be defined just before its related question). Please provide any supplemental comments that you wish to make either in the space provided under the question or on the reverse side of this sheet.

1. Installation: _____

2. User of which type of facility (check all applicable):

Family housing _____ Barracks_____ Admin. Bldg. _____Gym_____

3. *Performance*. The primary operating characteristics of the facility, such as meeting your work/shelter needs and providing water, heat, air conditioning, and ventilation.

Question. To what extent do you agree with this statement (check the most applicable response)? The facility I use performs to my expectations.

Strongly disagree___ Mildly disagree ___Indifferent ___ Mildly agree___ Strongly agree ___

Comment: (For example, did you find any unexpected performance features or glaring deficiencies?)

4. *Features*. The "bells and whistles" that supplement the facility's basic functions.

Question. To what extent do you agree with this statement? The facility I use has the features I would have expected.

Strongly disagree___ Mildly disagree ___Indifferent ___ Mildly agree___ Strongly agree ___

Comment: (For example, what features delighted you or what features are lacking?)

5. *Reliability*. Reflects the probability that the facility will operate properly within a given period of time.

Question. To what extent do you agree with this statement? The facility I use is reliable.

Strongly disagree___ Mildly disagree ___Indifferent ___ Mildly agree___ Strongly agree ___

Comment: (For example, express your delight with the facility's reliability or note the glaring deficiencies.)

6. *Conformance*. The extent or degree to which a facility meets preestablished standards.

Question. To what extent do you agree with this statement? The facility I use conforms to Army standards (at least to the extent that you understand the standards).

Strongly disagree___ Mildly disagree ___Indifferent ___ Mildly agree___ Strongly agree ___

Comment: (For example, express your delight with the facility's conformance with Army standards or note the glaring deficiencies.)

7. *Durability*. The life of the facility and its installed equipment (e.g., heating and ventilation system).

Question. To what extent do you agree with this statement? The facility I use is adequately durable (e.g., at a minimum, withstands fair wear and tear).

Strongly disagree___ Mildly disagree ___Indifferent ___ Mildly agree___ Strongly agree ___

Comment: (For example, express your delight with the facility's durability or note the glaring deficiencies.)

8. *Serviceability*. The case of repair, speed of repair, and competence and courtesy of the repair staff.

Question. To what extent do you agree with this statement? I am pleased with the maintenance and repair service I receive at the facility I use.

Strongly disagree___ Mildly disagree ___Indifferent ___ Mildly agree___ Strongly agree ___

Comment: (For example, express your delight with the maintenance and repair service or note the glaring deficiencies.)

9. *Aesthetics*. How a facility looks, feels, sounds, or smells—interior and exterior.

Question. To what extent do you agree with this statement? The facility I use is aesthetically pleasing.

Strongly disagree___ Mildly disagree ___Indifferent ___ Mildly agree___ Strongly agree ___

Comment: (For example, express your delight with the facility's aesthetics or note the glaring deficiencies.)

10. *Other perceptions that influence judgments of quality*. Such factors as image, culture, and reputation of the Army that are reflected in the facilities

Question. To what extent do you agree with this statement? Working or living in my facility makes me feel proud to be part of the Army family.

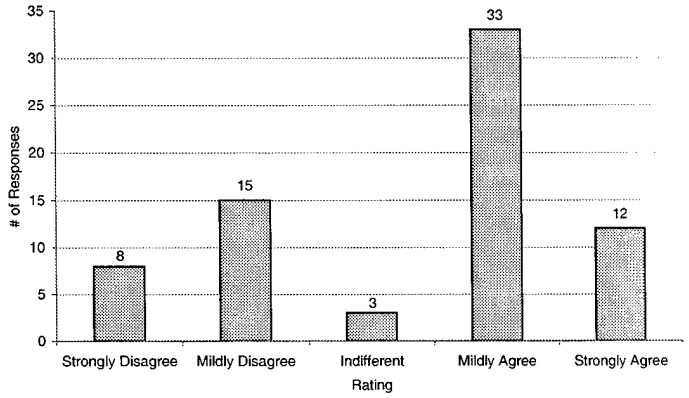
Strongly disagree___ Mildly disagree ___Indifferent ___ Mildly agree___ Strongly agree ___

Comment: (For example, identify those other perceptions that positively or negatively affect your view of your facility's quality.)

ANNEX C-2. QUALITY FACTOR CHARTS

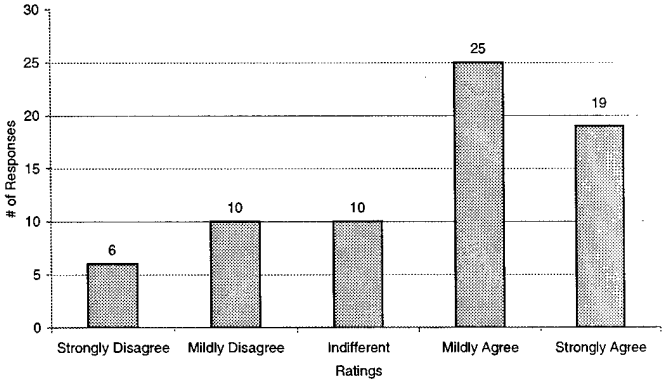
The following charts show the distribution of responses and the median response for each of the survey questions for the eight quality factors. Each chart shows the rating of the responses on the x-axis and the number of responses on the y-axis. For example, Chart 1 shows that 33 survey respondents mildly agree that the facility they use performs to their expectations.

Chart 1: Performance



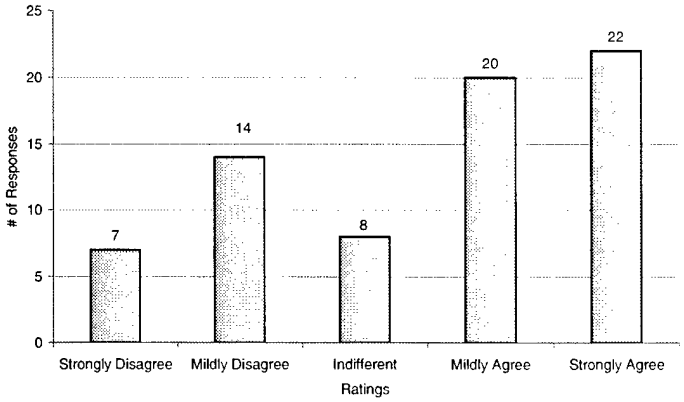
Median Response
Mildly Agree

Chart 2: Features



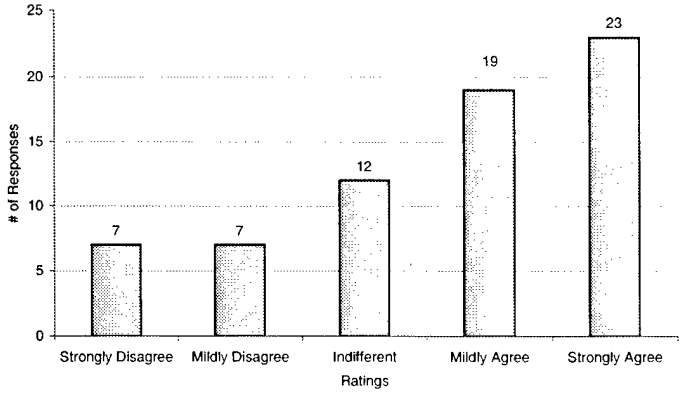
Median Response
Mildly Agree

Chart 3: Reliability



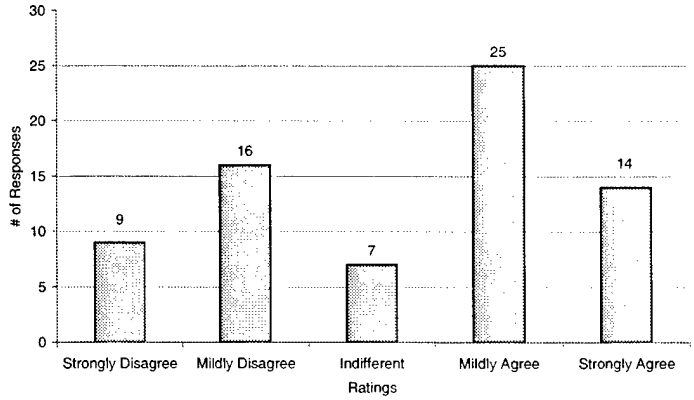
Median Response
Mildly Agree

Chart 4: Conformance



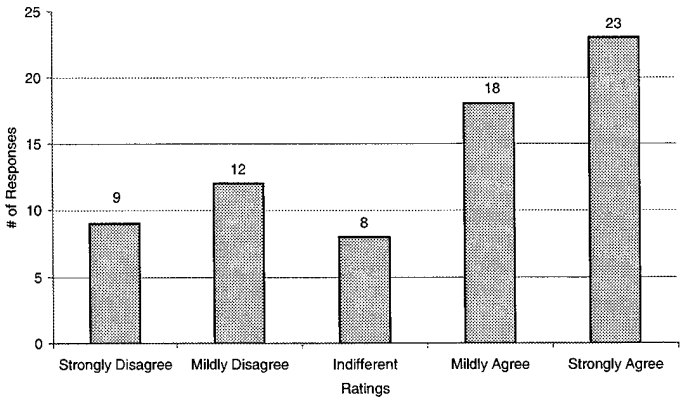
Median Response
Mildly Agree

Chart 5: Durability



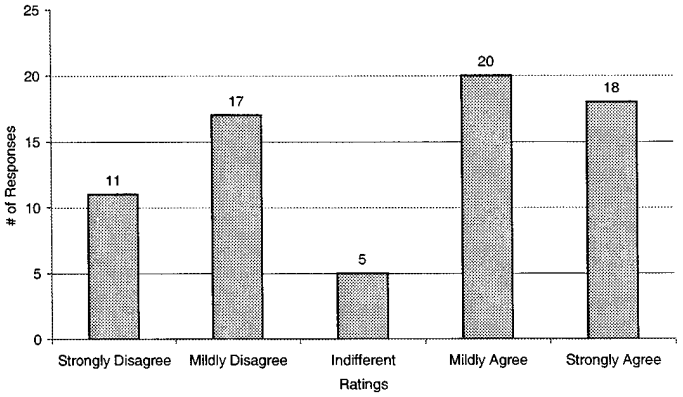
Median Response
Mildly Agree

Chart 6: Serviceability



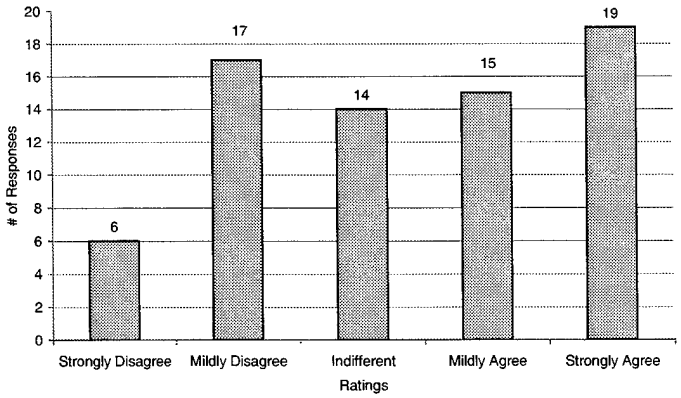
Median Response
Mildly Agree

Chart 7: Aesthetics



Median Response
Mildly Agree

Chart 8: Other Perceptions



Median Response
Indifferent

ANNEX C-3. COMMENTS

In this annex, we quote the comments made by respondents to the user satisfaction survey. (The comments have been slightly edited for grammar and clarity.) We have organized the comments into eight categories: performance, features, reliability, conformance, durability, serviceability, aesthetics, and other perceptions. Within each category, we have classified the comments into positive comments and negative comments.

Performance

POSITIVE COMMENTS

My facility is modern.

The HQUSAG barracks are up to a soldier's living standards. They have two main rooms with kitchen space and it's better to only have two people using a bathroom.

Recently remodeled, everything is new.

I found that the facility had more than I expected and have no deficiencies other than the heating, plumbing and A/C.

I am happy with heat in the winter and A/C in the summer. The building I work in also allows individual areas to control temperature in their immediate area.

The gyms are great in all respects.

The administrative building was just upgraded and it is very nice. Several on post still require much work. All the gymnasiums in Ft. Hood have been upgraded in the past 3-4 years. Some infrastructure upgrades are still required.

Newly renovated buildings with no glaring deficiencies.

Provides the basics, no more no less.

We have thirteen facilities that vary from a condition code of green, amber, and one red. Eleven of the thirteen buildings are in good condition.

NEGATIVE COMMENTS

The ventilation system needs to be cleaned because there is a lot of dust. Some people cannot used their washing machines at the same time, if they live next to each other.

Housing in the pre-1990s is scary.

The stairs are a bit steep for small children.

The gymnasium's ventilation needs work. During the aerobic classes, the heat needs to be regulated. There is no air conditioning in the buildings.

There is no air conditioning in the barracks or housing. You just have to sit there and burn.

There is no air conditioning in the barracks.

Off-duty usage of pool at gym, because hours are limited due to spouses' swimming practice.

A contract was issued to have the hot pipes repaired due to asbestos and it was supposed to take one day. The hot water was going to be off on Friday from 7:30–16:00, but we didn't get hot water back until Tuesday.

A tree fell off on top of my house and it took two days for it to be removed. The tree should have been removed long ago. It was a hazard because it could've been on top of someone.

Lack of ventilation in the barracks.

Poor ventilation, all doors must remain closed due to fire codes. The windows in the staircase, which could help with circulation, were not designed to open.

Need GCI outlets.

Security risk, no hot water and no A/C in operation.

It seems that there is a problem regulating the A/C, some parts of the building are too warm and other parts are extremely cold.

There is no A/C in the gymnasium. The buildings are old.

The A/C has coding problems. Continuous vapor locks.

The A/C has not worked for the past three days with temperatures exceeding 90 degrees.

Housing temperatures vary as much as 10–20 degrees between upstairs and downstairs. The gymnasium needs more air vents because it is too stuffy.

Heating and A/C units are not equipped to adequately heat or A/C the entire house. Upstairs stays hot and miserable in the summer and freezing cold in the winter.

Converted warehouse used for administrative building presents numerous safety issues.

Design errors in heating and cooling system.

DPW lacks response and work progress.

Pipes are getting old and repairs are done every month.

No fully handicapped accessible. It is not customer friendly and the parking is overcrowded.

In housing, the HVAC does not work in all the rooms. Water has black flakes and white particles with little explanation.

Specifically in Hammond Hills, there is low water pressure, insufficient telephone jacks and poor lighting fixtures. Why did we spend thousand of dollars for aesthetic carports? That money could have been used to renovate bathrooms and kitchens.

Would it be possible to build a housing area or homes with five bedrooms for families with more than three or four people, instead of "squeezing" children in a room?

I live in the Cherbourg housing units that are under renovations now for more than one year. My residence is on Sicily Dr. There is only one bathroom and the A/C for these quarters is really bad. You are either hot upstairs or freezing downstairs. I think it is because in the units upstairs, the air comes in from the doors.

There is no central control in the heating and the A/C. All vents run into each other, causing sound travel. The shower and the faucet pressure vary due to toilet flushing along with temperature.

The HVAC system is very erratic. Some rooms may be 90 degrees while others are 50 degrees, with no local controls. Sometimes, it might be 80 or 90 degrees outside and the heater will still be running. The vents in the rooms have no control valves on them and they conduct sound throughout the building. The shower water often goes from hot to cold in a matter of seconds.

There is no A/C, the electrical system is inefficient, the flow of traffic into the building is difficult to control, and there is always something broken.

The HVAC system does not have temperature control, it is old and it has frequent failures.

Shortage of space because allotted space per troop.

Not always—problems with electrical wiring overload, HVAC system sometimes breaks down, ductwork has never been cleaned and filters are rarely replaced.

Need storage and space.

Administrative building lacks adequate outlets, LAN drops and telephones jacks. At times, A/C is ineffective. In the gyms, locker rooms and shower room facilities are too few and too small.

We have many administrative areas that have none or have substandard HVAC.

The barracks need their own restroom.

There are too many birds under the barracks.

Mainly more bathrooms and showers for gyms.

Rooms leak on the third floor, run out of hot water during peak times. The flat roofs we have are failing because of lack of maintenance.

Features

POSITIVE COMMENTS

HVAC affords year-round comfort.

I do most of my shopping and other items of interest off post. I have a nice community center.

Controlled temperature and good lighting.

They feature a variety of things. The problems are with the staff, not the facility.

The gym has very good equipment for soldiers and spouses to use.

I like the washer, dryer and dishwasher, although I believe that we lack microwave ovens.

There is fresh paint on walls, nice carpets and excellent restroom facilities.

In my housing quarters, I truly appreciate the large walk-in pantry. Due to the age of my quarters, it was built with few cabinets in the kitchen so the walk in pantry is truly an asset.

The gym is great except for no A/C or sauna.

The HVAC and parking are good.

It has its own thermostat, so we have control over the climate.

The feature I like in my home is the outside appearance. Overall, I also like having 2 ½ baths. This is really convenient having more than one bath in case one stops working. The garage was an excellent addition to the facility and I am pleased to say that nothing was lacking.

There are individual office rooms and good bathrooms.

This post has plenty of gyms to choose from, which deters from overcrowding one particular gym. Most of the gyms I have been to have a friendly staff and the equipment appears to be maintained and serviced on a regular basis, which I find helpful. I wish the post would add an indoor track to one of the gyms for inclement weather.

The cardiovascular equipment and the weight training equipment are exceptional.

Administrative and gymnasiums are very nice. The gymnasiums are "state of the art."

It provides for a very professional atmosphere to conduct work.

The assortment of equipment is excellent.

It is a delight to have a microwave, a small kitchenette and a bathroom.

After renovations, the gym is excellent; so I strongly agree.

I enjoy having a microwave.

I am unaware of this feature.

The barracks have some nice features, such as the barbecue grills and basketball courts.

NEGATIVE COMMENTS

The features that I think are lacking are ground areas. It is extremely difficult to try to grow grass in certain areas. There is a limited amount of storage.

It does have a dishwasher and a disposal. The laundry room is crammed in with the furnace and hot water heater, so there is not enough room.

We could use air conditioning in housing.

However, some of the other battalions have it a lot nicer than ours with a weight room, TV room and other minor staff.

The kitchen is way too small, we had to buy a storage cabinet for our food due to lack of cabinet space. I have to go into my neighbor's yard every time I want to use the faucet because there are only four faucets for eight apartments.

There is poor circulation of air. I had problems with contaminated water due to old pipes, so we must use a filtering system on the drinking fountains.

We need 1st floor closet for guests' coats, eat-in area in the kitchen and carpet in the dining room areas. Some quarters need more than one bathroom.

A/C and hot water are lacking.

Most soldiers need larger living quarters, modern furniture, etc.

A garage or a carport would be nice with the intense heat and the snow we get here.

I am responsible for the M&R of the barracks. The need exists to improve the exteriors and the utility systems of the barracks in the 8400, 8500 and 8600 areas.

The size and condition of the building are deplorable.

There is no elevator, deliveries for second and third floor must be carried.

We lack a larger aquatic facility.

The HVAC system is flawed.

As the division construction officer, I know the "bells and whistles" are the first things that are cut out of a project due to funding. The new barracks being built across the post are better than the ones circa 1950s barracks, simply because they are new. However, soldiers complain about being unable to open and close vents in their room, insufficient water pressure that turns hot to cold constantly, insufficient noise reduction materials in the walls to allow privacy in their own bedrooms and bathrooms.

Quarters comment is above. A/C, heating and layout are not good in Cherbourg Housing.

Poor fixtures, lots of closet space and no shower pressure control.

The barracks are lacking in more fundamental areas such as handicapped access ramps and possibly an elevator to get to the second and third floor (we do have a fair amount of injuries from jumps).

Lee PFC is an old building. I can't expect much at this time. However, it should have a higher priority for renovation due to its extensive use and location.

Same comments—carpet is old and dirty, building tiles are old, broken and stained. No OMA funds provided for improvements.

Needs storage and space.

Open office system is very poor for working conditions. It limits work performance.

The Army has placed demands on the units that the facilities can not handle. Supply rooms and admin areas do not have sufficient space.

I do not like having to lock up all personal items.

It needs bathroom in each room and maybe carpet.

Small rooms, poor ventilation and heating, lack of power outlets, hard to clear when moving out, cleaning standard is too high and no lighting in the living room.

It needs elevator access to second floor, upgrade to facilities to increase use areas, showers and locker areas.

The building I live in is old. I would expect newer cabinets, etc., to be installed at some point. However, the ones we have are serviceable.

Not designed for administrative purposes or modern day computer room servicing the installation.

All gyms lack A/C.

Lacks size and space.

It needs A/C, ventilation, water, electricity and phone.

The facility is not large enough to accommodate expanding mission requirements and support staff.

Reliability

POSITIVE COMMENTS

It has occasional glitches, but for most part it is reliable.

The majority of equipment is repaired and ready to use and the opening and closing hours are consistent.

There are minor problems; however, DPW is very responsive to work requests.

Our facility has backup power and generator for power outages. The facility is in good condition and there is a continuous quality maintenance.

The facility I operate is pretty reliable.

The gymnasium is a reliable facility: the hours open and available are flexible. In addition to this, any unserviceable equipment is fixed and made serviceable promptly.

Here at Fort Richardson they seem to do more consultation on housing and other facilities to get them up to great standards.

Being a home built prior to A/C it is a solid home with good ventilation and sound proof. During the flood of '98, no problems were encountered with my roof leaking or basement flooding.

"State of the art" equipment. Jacuzzi has a nice appearance.

I haven't had any problems with my quarters.

The housing is reliable.

The gymnasium has good hours.

I believe that the facility is reliable but as with any facility, after time it will need to be maintained as needed (plumbing and heating are a problem).

NEGATIVE COMMENTS

Again—admin buildings 2272 and 2273 require significant upgrade.

Need shifting floors and walls.

Design errors in the heating/cooling and water systems.

There are ongoing problems with the electrical, plumbing and heating systems.

It has quite a few more appliances that are not serviced properly.

Deficiency in the power supply, it is not very dependable.

Walls separate from ceilings twice a year. They were built too fast and given no time to settle.

In the barracks, it takes a while for equipment to be fixed or repaired.

I don't think that building 977 was design to last more than 40 years and all the renovations have made it look good. However, sometimes it is just best to build another building.

I don't know about long-range plan for administrative office space in warehouse type building.

The walls seem to always crack in housing area.

BEQ is falling apart. There are water leaks in the basement.

For the most part yes. But, when something does go wrong, it takes forever to get it repaired.

The gymnasium is too small and crowded for the number of personnel.

Even after putting in sump pumps, the basement still leaks. There is lead base paint on the house and asbestos inside the crawl space downstairs. When this was brought to the attention of medical personnel, we were told that it was not enough to worry about.

BEQ is old and inadequate.

Work orders are not completed. Residents are given the run around by the base employees.

I disagree. Not in the present, but in 5 to 10 years from now. Due to lack of funding and budget cuts from ACSIM, HQDA and others, the life expectancy and reliability of the barracks being built now will not hold up or endure normal wear and tear like the 1950s hammer heads our soldiers live in now. Faith barracks, completed in 1997, already has multiple problems with the HVAC because a lower quality of equipment was installed instead of the recommended one. Paint is peeling off the walls due to poor coating and texture.

Family housing in Rhine Rd, Altavilla and Sicily Dr. needs to be torn down and rebuilt to support a family of 4 to 5 people. In my opinion, one bath, poor heating and A/C is not suitable for any family in Fort Bragg. The gymnasiums are excellent.

Materials are cheap and not very durable. The paint washes right off on the inside and is chipping on the outside.

The water heaters have to be worked on often. The light fixtures in the closets do not work and bulbs are hard to find. Several showers have had plumbing failures resulting in water damage to multiple rooms. Some toilet fixtures have been failing to flush.

Something is always breaking down. Staff cannot use the microwave without blowing a fuse in the building.

As noted heat, A/C and plumbing.

Same comments (not always—problems with electrical wiring overload, HVAC system sometimes breaks down, ductwork has never been cleaned and filters are rarely replaced).

Broken A/C and showerheads.

A/E was not very responsive to user requests.

The A/C and heat goes out 2 to 3 times a week.

The administrative building and the gymnasium I use are basically new. Does not reflect postwide situation. 15 years of my office being in a wood building is not reflected. 1.5 million square feet of wood remain in Fort Hood.

A review of the service orders called in for any given building will support this answer.

Excellent facility but lacks adequate parking.

Takes All Star too long to take care of housing issues, such as clogged water line and lack of hot water.

Need upgrades to electrical, ventilation and plumbing.

Heating systems fail often, bathroom facilities.

Conformance

POSITIVE COMMENTS

As far as I know, everything is within Army's standard.

What is the definition of standard?

The gymnasiums offer a lot.

The gymnasium has up-to-date equipment. The clubs offer a variety of activities to choose from. Might consolidate facilities together, for example phone center, travel agent and PBX.

Very nice quarters, exceeds my family needs.

I like the standards the Army sets for housing, except that there should be a rule about picking up animals' droppings because it is disgusting and smells bad.

I am sure it meets some or all of the standards. However, I understand that some of these standards were made back in the '40s or '50s.

Don't know Army standards for administrative buildings.

Living in housing is a privilege and many residents have expressed how having a fence installed when built or to upgrade the quarters, would be an added benefit to family life in housing.

For what I would receive for BAQ I could have a better living condition at some post and bad condition at others. Family houses do meet for the most a high standard of living condition for your family.

Army standards or better.

110% better than at Fort Jackson.

NEGATIVE COMMENTS

The existing staff is helpful, but they are not trained fitness professionals. Appropriate fund hiring procedure limits staffing potential.

It conforms to the minimum acceptable standard.

Housing meets the Army's poor reputation, except in post-1990 structures.

Housing is like any other post, it could be better.

I have no idea what the Army standard is for housing. However, I understand that some of these standards were made back in the '40s or '50s.

It is easy to break into.

It would make a great warehouse.

The Army standards are much lower than other services.

BOQ's/SEBOQ's lack of exterior and interior maintenance, walls covers falling down, late 1960s look. The exterior is rusted, the paint is faded, the interior carpet has never been replaced, it is old and dingy.

I know AF standards and my opinion is poor here.

Again, lead base paint and asbestos.

Army tends to have low quality housing, so the condition is not surprising here. However, we do tend to have really small and inadequate housing.

The Army is still working at upgrading their substandard living issues. Therefore, the Army standard is low compared to other branches of service.

I would hope the Army has higher standards than this.

N/A. Air Force barracks may conform to Army standards.

I am not sure I know what "Army standards" are. I know what Fort Bragg soldiers need and what materials will be necessary to build barracks that will live up to the wear and tear of barracks living. Master planning at Fort Bragg and the Army as a

user know what we need. However, we are always told to settle for less of a standard due to funding.

It is not within the IRS standards.

Building 2015 is the newest standard on Fort Lewis. The end user receives the building that is outdated.

The Army is making gains with building and remodeling the facilities. Unfortunately, we are building behind the power curve. From drawing to finish product it takes years. A building delivered today was designed and negotiated 3–4 years ago. By the time the end user receives the building, it is outdated.

I think that the Army should take some more funds and finish redoing the entire Cherbourg housing area. I also just move to Bataan, they need to redo the kitchen cabinets, they only have a total of six two-door cabinets. There is no storage space in the kitchen.

The barracks seem to meet safety standards but are probably well below the Army's reliability and durability standards.

I think that the quarters meet Army regulations but the standards need to be raised a little from 50 years ago.

The equipment, condition and design of the building do not currently comply for a world class Army fitness center.

It needs ample, individual space.

A/C system in one portion of the building has problems. It is not a glaring deficiency, but it is an issue.

Residents in some areas on Fort Bragg live in "ghetto" housing, which they feel is below living standards. These buildings are being renovated. Limited amount of privacy.

Durability

POSITIVE COMMENTS

My facility has just been renovated.

As much as I can tell, are pretty good.

Strong enough through storms.

All installed equipment works. Fort Lewis does not have A/C requirements.

Fort Hood physical fitness center set the Army standards.

It's a new building so everything seems to be working well.

In keeping with the quarters being from 1930s all equipment is functioning properly and housing/DPW maintains the equipment to assure that we don't experience too many problems.

I am not sure just how durable the facility is, but I am sure it will withstand the weather in North Carolina.

NEGATIVE COMMENTS

Buildings 915/916—barracks heating system "under-engineered"; need much improvement. Soldiers deserve heat and hot water in the winter.

HVAC problems, power failures.

Over 2,000 people per day use the facility. Maintaining the equipment is a challenge.

The floors are cracked. The paint on the walls is of such low quality that you can not even wash it with water or it will come off.

We have some initial design problems with newer facilities.

Things like garages and other buildings do not seem level. Electricity goes off at the drop of a dime.

No deficiencies noted. Need maintenance and facility management with a good plan to maintain systems.

Heating would work well in housing if they would fix all the drafty windows.

Sometimes the heating will break or you will not have hot water in the barracks for 3 or 4 days.

Some heaters in rooms do not work.

There is no control over heater in the barracks.

My heating system is having problems, there is a loud humming noise coming from my pipes if the thermostat is below 70 degrees.

A/C and heating is good, just very poor ventilation in the upstairs. Stays hot in summer and cold in winter on the upstairs level.

Building built poorly. There is heat and A/C problems weekly.

The products are lacking in the ability to do the job needed for any length of time.

Again, the commercial construction standards being forced upon us by ACSIM and HQDA will last a couple of years. However, this style of construction will not last 25–50 years in a military environment.

It works, but it continuously needs repair. The system is old and it is repaired by patchwork.

The systems are old and break down a lot. There is poor water drainage.

There are many breakdowns.

Sometimes it is difficult to keep the house warm. For example, the downstairs will be warm or cold and the upstairs will be just the opposite. This is frustrating for the residents in winter.

Family housing in Cherbourg Community heating and ventilation system, in the old quarters Rhine Rd., Altavilla and Sicily Dr. is really poor. You keep hot upstairs all summer long with the temperature at 65 degrees and downstairs freezing at 45 degrees.

The systems that we have were intended to last for a short period of 10 years and they have exceeded that.

Plumbing, electrical and access.

My quarter has poor ventilation and the heating cannot be set at a comfortable level.

The heating system seems old and the bathrooms not vented.

When systems are new, all is well. It is when they age, and with little or no preventive maintenance done, that there are challenges.

Heat and A/C drainage need work upgrades.

Users are constantly changing temperatures. Thermostat should be placed where users cannot make any changes.

About a year after a multimillion dollar renovation, the A/C went out because a second hand chiller unit was installed during renovation. It took almost 5 months, through summer, to get repaired.

I think it needs more insulation. It is hard to keep my house cool. Otherwise, seems to be built fairly well.

The heating system here is not all that great, it has too many problems keeping heat over periods of the winter in Alaska. The heating system works well. How-

ever, there is no ventilation system and there is very little air circulation in the winter due to all the closed windows. In the summer, there is very little air circulation due to poor design in the windows, in the staircase and throughout the building.

It needs thermostat and air circulation improvements.

The facility is very old and worn. I don't think anybody is planning to put money into it.

It is difficult to regulate A/C and heat in different parts of the building.

The paint washes right off on the inside and it is chipping on the outside.

The interior paint cannot be washed without coming off and the exterior paint is largely chipping off or fading. The drywall walls take a beating from the field equipment coming in contact with them.

No A/C or heat in the winter and there is no good circulation of air.

Heat and A/C is old and out of date. There are frequent leaks from failed plumbing.

Serviceability

POSITIVE COMMENTS

Housing and barracks, very pleased with service.

We have a roving maintenance contractor and in-house (dedicated) DPW employees to maintain our facilities. We also supplement with DPW staff as required.

I am pleased with the maintenance and repair now that my spouse is the community mayor. Prior to this, it seemed to take quite awhile.

Excellent maintenance/repair services. Our PM is proactive in management.

Off-post housing maintenance is completed timely. I haven't had any problems when I call and ask for a repair. If it is a continuous problem, they always try to solve the problem and try different things.

I have no problem with getting people out to repair anything in my apartment.

Once the servicemen come to fix any type of problem, their work is usually efficient.

DPW does an outstanding job reaching to any request I have made. I was very satisfied with the maintenance work that was done. Good job.

Response to maintenance called in for repair to quarters is done in a speedy time.

Only been in the facility for a month or so, but when the A/C was out one morning, a repairman was there very quickly after a call was made.

I had no need for repairs in the last year.

Housing/DPW strives to correct problems quickly. An area of concern is the telephone line in housing, depending on the amount of rainfall or the appetite of the squirrels. Quarters have experienced lack of service for days.

But this is a DPW facility.

DPW is great.

Repairs are speedy and adequate. Buildings need renovation.

Could not ask for better support from DPW.

DWBL staff and personnel do a great job. The problem is that there are too many deficiencies in the quality of the material.

Some of the maintenance staff is friendly and good at explaining problems and corrections. I have no problem with the amount of time it takes for them to come to my home for repairs.

They come and patch things up. That is the best they can for such old family housing.

The maintenance staff know the importance of maintaining this facility and they respond in a timely manner.

Maintenance people do what they can and they are always courteous.

During fitness center renovations, durable materials such as phenol lockers were installed. They are very durable and still nice looking after 4 years of hard use.

DPW maintenance does all they can with small amount of money provided for installation facility repair and maintenance.

Tecom has always responded in a timely manner when called.

Most work orders, for the administrative building I work in, are completed timely. Of course, we are DPW.

If we have a problem with the building, the service people fix it promptly.

The DPW does what it can. They are overburdened and underfunded. In all fairness, they do the best they can with what they have.

I have not needed repairs.

PW shops provide timely repair. Warranty is providing most maintenance and repair because construction was just completed.

R&U soldier does a great job in fixing things.

Repair calls are responded to with speed.

Repair can only do so much. The building is scheduled to be demolished.

NEGATIVE COMMENTS

It takes 2–3 days for repairs, but the problems are not fixable.

They are difficult to get after hours. Sometimes it takes several calls and several visits to get one problem fixed. When they renovated, we have had problems with appliances that they stood on.

It takes forever to get something fixed in housing or the barracks.

Sometimes we would go a day or two without hot water and sometimes we would have to ask more than two times to fix something and it takes forever to get fixed.

In the barracks, speed of repair takes too long to fix.

I am not always pleased with priority of repairs and priority of project status for housing and barracks

Refer to question seven. I think they would rather see it fall down.

Trouble calls are not worked timely. DPW database lacks detail of accurate problems. Problems often closed before problem is fixed.

It takes much too long to have a maintenance problem repaired.

It takes too long for work orders and quick fixes do not last.

It has gotten better within DPW. When we first arrived, the people were extremely rude but I don't see any of those faces anymore and personnel has gotten better. Now, if we could get them to stop cutting the grass so short. We try to maintain the common area around our house and when they mow, they mow so short it hits dirt.

Call in a work order, maybe in three months you will see someone and then it is only to see how the repairs went. The majority of workers complain about the fact they will be out of work when the post is privatized.

The government employees' work is performed in reasonable time. Contracted employees work is performed after unnecessary calls and contacts are made.

Work orders for repair (essential) take too long to close.

I like working and dealing with the maintenance men that service the buildings, however, dealing with the supervisory end, it is sometimes very hard to get things done.

A few workers are polite and do the job well. Most lack personable skills and treat residents rudely. Time frame for repairs should be reviewed.

I feel as though being a new housing area and still under contract that they can be a little more concerned and timely in maintaining the quarters.

Many minor repairs such as the closet light fixtures go unrepaired for months or years. Major deficiencies do see to get repaired but often breakdown again.

It depends on dollars.

As the facilities engineer, I manage all facilities work requested for my division. The turnaround time is much too long for even the simplest of repairs. On a yearly basis, approximately 10–15 work orders get completed for a division with over 300 permanent facilities.

When systems go down, there is a long waiting period for repairs because of funding levels. Last year, the gymnasium's A/C was down for 6 months, and it was very uncomfortable during the hot Texas summer.

It takes too long and sometimes you can loose a day of work waiting for All Star to come and most of the time when they cancelled they will not even give you a call to let you know.

It has improved in the last six months, but it is still difficult to get new work or upgrades to facilities.

The equipment is maintained in house. HVAC system and other utilities lack routine maintenance and system failure is frequent.

Lack of maintenance personnel slows up the process. Bad communication between service personnel and users.

Aesthetics

POSITIVE COMMENTS

Most appearance is excellent.

The home does look nice on the outside and inside.

It looks nice on the new post.

Our facility is highly maintained.

For the most part, the interior as well as the exterior landscaping is up to par on the standards behalf.

The administrative building is about as pleasant as a warehouse turned admin could be. The new bathrooms are nice.

Outside the building, there is a well maintained lawn. Inside the building, there is fresh paint, fairly new and very clean carpets, bright/clean restrooms and plenty of parking.

Recently remodeled. Everything looks new and clean.

The new design aesthetically looks great.

The facility is beautiful and I feel very fortunate to be able to live in this facility. It makes you feel like all the hard work my soldier is putting in, it is not in vain.

For the most part, the quarters are attractive. There are some things that are a little outdated and need to be replaced but still function.

The division's HQ is kept up very nice by the HQ staff. The gymnasium is kept neat and clean by its staff.

Ft. Hood has a great master planner.

Newly renovated, employees have stated that it is the best facility they will ever work in.

The facility looks like a standard barrack, but the landscaping has improved.

Newly renovated buildings are aesthetically pleasing.

NEGATIVE COMMENTS

The old post looks run down.

Two facilities need work.

The only problem is the cleaning contractor. Routine cleaning of lavatories is fair.

I do like the siding on the outside of the house. Inside it is difficult to keep clean due to the dust and paint quality. Several of the units I have been in have refrigerators missing handles in stoves.

The older homes look old.

Some areas of facility need repairs such as painting. Need more compliance to regulation by staff.

Division plays music during PT hours.

Too small, my youngest child's room is the size of a walk-in closet. Not a big enough kitchen.

Sometimes it is better to destroy and rebuild them to continue to renovate. On paper, renovations seem much cheaper. However, in the long run it would be better for those working in the facility to have a safer and cleaner building built to the current standard.

Better sound barriers would be appreciated. Also smoke and pet free quarters. Higher fences, increase from 4 feet to 6 feet.

It is an old tin building that smells like mold and makes you feel depressed when you look at it.

Housing exterior and interior is old and should be renovated.

All BEQ outside needs an overhaul, especially painting.

Totally ugly/SEBOQ/BOQ.

Need paint! No outside upkeep: roofs and gutter are problems.

The peeling lead base paint is an extreme eye sore.

From the outside, thanks to new roof and siding on houses, they look great. Just do not go inside or paint chips might hit you.

The building I use needs extensive interior work.

The equipment is well maintained, but some fixtures in locker rooms have been poorly installed. They have not been built with proper materials.

Lead paint and exterior is substandard. The smell is also an issue.

Some of the housing on Ft. Bragg is in need of repair. That is in the works now; but it is a long overdue project.

The quarters on Sicily, Altavilla, Rhine Rd. is an eye sore (old and ugly). Altavilla, Rhine Rd. have been renovated to look better. Sicily is due to be torn down in a year.

You can hear everything from upstairs, downstairs, next door, and down the hall. The sprinklers are always broken.

It is old and there is a lot of wasted space.

The speed of repair could be improved.

Colors are bland—no accents. When other buildings have used color, the command staff has required an education in color use to accept.

The building needs upgrade.

Most buildings are old. New paint and energy efficient doors and windows would help.

Sometimes it smells when somebody cooks.

Sometimes the back of the building smells like gas.

Old and beat up, small and bad ventilation.

The oldest building is 1938 and youngest is 1984. Need of aesthetic upgrades.

Interior walls are very thin, you can hear your neighbors.

Other Perceptions

POSITIVE COMMENTS

Much pride is taken in our Real Property (maintaining and appearance).

The people in my community make it a good place to live.

My facility is modern. Good housekeeping set up to meet customers needs.

I can live anywhere and still be proud to be in the Army.

It is all right for what we have.

The college option for reenlistment is great.

Military is a fast "friend" establishing community, so there is no lacking there. Some of us go out of our way to improve our living condition, which helps with the overall moral.

I am in the Navy.

The new barracks aesthetically look great. What they look like 5–10 years from now will drastically change the image. The new separate battalion barracks and

the combat aviation brigade under design are so limited on funding that they will not aesthetically look as nice as the faith barracks and 1st brigade barracks. Such a difference in living facilities between units will drastically affect unit morale.

I am in the Air Force, but living and working in Army buildings.

I feel that if residents are having the privilege of living in government housing, they should be forced to maintain the grounds and house they occupy.

Nice color combinations, plants, fish aquariums and clean facilities.

I do feel a sense of security living on post. Also, knowing that all of your neighbors are in the same situation you are in.

The quality of life is a top priority. Even if the facility is old, the user takes pride in keeping it in the best shape they can, under the circumstances, lack of funding, etc.

I am happy to come to work in a facility that looks nice.

Working for the Army is a plus. We do the best we can for the facilities based on dollar constraints.

The Army is trying with the dollars they receive to improve quarters. The soldier who is defending the country on call 24 hours a day, 7 days a week, deserves nice things. If the Army continues to take care of its soldiers and their families, they can serve better.

The condition of the building does not hurt my work performance. Sometimes, I feel that the installation could provide more dollars for facility improvement but I understand that the Army has other necessary requirements and limited funds.

NEGATIVE COMMENTS

The barracks I lived in building 668 were wonderful, but I have seen other installations such as building 664 and their living standards are below norm.

The Army enjoys renovating when it is clear that a new facility is needed.

I hate the comparison of appearance of local Air Force Base (Randolph) to Ft. Sam Houston. AF can use soldiers/FSH does not have soldiers available for labor use.

Again, all work is patchwork. The money is allocated elsewhere instead than on the facilities that house military.

If we could afford to live on the economy, we would.

In respect to the outside of the house, it is an eye sore. On the inside, it looks great.

Being Air Force, there is a feeling of being an outsider. It should be more of a purple post where all commands should work together.

Everything on Ft. Bragg is good, except for the quality of life for the soldiers and their family in some of the housing. We need to move into the 21st century as far as the standards of housing.

I accept that it is an old facility and soon will be renovated.

It is old, but well maintained; except for the average components used.

True for me, but I live off post. For those who live in A-style barracks, some company orderly rooms, several would answer quite differently.

Visitors think it is very bland and monochromatic.

The building needs upgrade.

My building is a converted classroom. I would say the condition of the building is on par with the rest of the division, which is poor.

I live in a very old set of quarters and I believe that the living conditions could be a lot better.

Buildings 2272/2273 present poor "first impression" to incoming USAG soldiers.

It's a make-do situation. I feel your survey should address communication issues in all areas; for example, in barracks and in administrative buildings. This, I feel, will give you a better understanding of problems in the communications arena.

I believe that the quality of life preached is set at the minimum standard needed to give the soldier the idea that he is being adequately taken care of.

Appendix D
Impact of Federal Government Contracting Requirements on Design and Construction Costs

INTRODUCTION

In recent years, the federal government, under the Government Performance and Review Act, has undertaken initiatives to downsize and eliminate government "red tape." One area of concern to design and construction firms that do business with the federal government is the burden associated with federal contracting requirements. LMI, in conjunction with the American Consulting Engineers Council (ACEC), conducted a survey to quantify the extent of that burden. In particular, we sought to answer this question: By what percentage does compliance with federal contracting requirements raise design and construction costs as compared with the costs of similar projects completed under typical private-sector contracts?

APPROACH

We identified 44 contracting clauses, generated by regulatory action, legislation, or Executive order, that may have an effect on the cost of doing business with the federal government. Those clauses generally fall into four categories: socio-economic clauses, cost control and accountability clauses, business protection clauses, and labor statute clauses. We also identified other requirements—restrictive technical and material specifications imposed by the federal government on its design and construction contractors.

In the survey instrument (see Annex D-1), we asked the respondents to consider each of the five categories of federal contracting requirements and to estimate the percentage impact on design costs and on construction costs for each (we asked for estimated percentages because corporate accounting systems generally do not track the specific costs of complying with federal contracting requirements). Table D-1 shows the possible responses to the survey questions.

Table D-1. Possible Responses to Survey Questions

Type of contract	None	Less than 2%	2% to 4%	5% to 7%	8% or more (please specify)	Not applicable
Design	1	2	3	4	5 (__%)	6
Construction	1	2	3	4	5 (__%)	6

We also asked for company background information, including gross billings, percentage of total dollar volume of work done for the federal government, and number of employees. Finally, we provided a section for respondents to clarify their answers or provide additional comments on federal government contracting requirements.

We mailed the survey to more than 4,000 ACEC member firms in April 2000. Member firms were to respond only if they had done federal government design or construction contracting within the past 5 years. The survey elicited 291 valid responses, a 7 percent response rate.

After collecting the survey, we grouped the responses into design costs and construction costs for each of the five categories of federal contracting requirements. Next, we created a distribution of responses and calculated the median response. Annex D-2 contains a full analysis of the responses for both design contracts and construction contracts, and Annex D-3 contains respondent comments.

SURVEY RESULTS

Participants were unanimous in their belief that complying with federal government contracting requirements increases both their design costs and construction costs. The respondents indicated that their design costs are about 6 percent higher on federal government contracts than they are on private-sector contracts and that their construction costs are about 9 percent higher. Respondents attributed half of the 6 percent increase in their design costs to the need to comply with cost control and accountability clauses, such as Audit and Records, Subcontractor Cost or Pricing Data, and Cost Accounting Standards. They attributed two-thirds of the 9 percent increase in their construction costs to labor statute clauses, such as the Davis-Bacon regulation and other restrictive technical and material specifications. Table D-2 and Table D-3 show the estimated percentage increase in design costs and construction costs attributed to federal government contracting requirements. The responses to questions about the impact of federal contracting requirements on design costs and construction costs are generally the same, regardless of the amount of work done for the federal government or the firm size.

Table D-2. Estimated Percentage Increase in Design Costs Attributed to Federal Government Contracting Requirements (Median)

Category	All respondents	Respondents with >75% federal work	Respondents with ≥30 employees	Respondents with ≤30 employees
Social action clauses	1	1	3	1
Cost control and account-ability clauses	3	3	3	1
Business pro-tection clauses	0	0	0	0
Labor statute clauses	1	0	1	1
Other require-ments	1	1	1	1
Total	6	5	8	4

Table D-3. Estimated Percentage Increase in Construction Costs Attributed to Federal Government Contracting Requirements (Median)

Category	All respondents	Respondents with >75% federal work	Respondents with ≥30 employees	Respondents with ≤30 employees
Social action clauses	1	0	1	1
Cost control and account-ability clauses	1	1	1	1
Business pro-tection clauses	1	0	1	1
Labor statute clauses	3	0	3	3
Other require-ments	3	1	3	1
Total	9	2	9	7

The following subsections discuss the analysis results for each category of federal contracting requirements for both design contracts and construction contracts. We reiterate the question, and the type of contract at the beginning of each subsection.

Socio-Economic Clauses

Question: *By what percentage does compliance with federal social action clauses raise your costs?*

Type of Contract: *Design*

The median response of 1 indicates that, in general, complying with federal social action clauses raises design costs by 1 percent. Larger firms indicated that social action clauses add 3 percent to their design costs. Typical comments were that the utilization of small, small disadvantaged, and women-owned small businesses is the most erroneous of the federal requirements because being forced to subcontract a substantial part of the firm's work cuts into revenue and has a negative impact in the quality of the firm's services. Another typical comment was that the most difficult requirement is affirmative action because, as a subconsultant on a multidisciplined team, they are often either burdened with meeting an unreasonable percentage of participation within their discipline or are excluded from teams altogether. Another comment from a member of a disadvantaged business enterprise (DBE) expressed resentment over the implication that DBE firms are less efficient or cost the project more.

Type of Contract: *Construction*

The median response was 1, indicating that, in general, complying with federal social action clauses raises construction costs by 1 percent. However, businesses that did work predominantly with the federal government suggested that federal social action clauses have no measurable effect on their construction costs.

Cost Control and Accountability Clauses

Question: *By what percentage does compliance with federal cost control and accountability clauses raise your costs?*

Type of Contract: *Design*

The median response of 3 indicates that, overall, complying with federal cost control and accountability clauses raises design cost by 3 percent. Smaller firms suggested that complying with federal cost control and accountability clauses raises their design cost by only 1 percent.

Type of Contract: *Construction*

The median response of 1 shows that, overall, complying with federal cost control and accountability clauses raises design costs by 1 percent, regardless of the amount of work done for the federal government or the firm size. Typical comments noted that the cost to the project is quite high when the construction costs and payroll reporting are counted. Another response was that audit

provisions are the most restrictive and expensive to administer and that government ought to replace fees tied to salary and overhead with a lump sum.

Business Protection Clauses

***Question**: By what percentage does compliance with federal business protection clauses raise your costs?*

***Type of Contract:** Design*

The median response of 0 suggests the general belief that business protection clauses have no measurable effect on their design costs, regardless of the amount of work done for the federal government or of the firm size.

***Type of Contract**: Construction*

The median response of 1 shows that, overall, complying with federal business protection clauses raises construction costs by 1 percent. However, firms whose business is predominantly with the federal government indicated that business protection clauses have no measurable effect on their construction costs.

Labor Statute Clauses

***Question:** By what percentage does compliance with federal labor statute clauses raise your costs?*

***Type of Contract**: Design*

The median response of 1 indicates the general belief that complying with federal labor statutes clauses raises construction costs by 1 percent. Firms whose business is predominantly with the federal government suggested that labor statute clauses have no measurable effect on their design costs. Typical comments included the statement that the elimination of the Davis-Bacon wage requirement is the best thing that could happen.

***Type of Contract**: Construction*

The median response of 3 shows that, in general, complying with federal labor statutes clauses raises construction costs by 3 percent. However, firms whose business is predominantly with the federal government indicated that labor statutes clauses have no measurable effect on their construction costs.

Other Requirements

***Question**: By what percentage does compliance with federal technical and material specifications raise your costs?*

***Type of Contract**: Design*

The median response of 1 suggests that, overall, complying with restrictive federal technical and material specifications raises design costs by 1 percent, regardless of the amount of work done for the federal government or the firm size.

***Type of Contract**: Construction*

The median response of 3 indicates that, in generally, complying with federal technical and material specifications raises construction costs by 3 percent. However, firms whose business is predominantly with the federal government and smaller firms believe that the compliance with federal technical and material specifications raise their construction costs by 1 percent.

ANNEX D-1. SURVEY INSTRUMENT

Socio-Economic Clauses

Q-1. Examples of social action clauses included in federal design and construction contracts are as follows:

- Equal Opportunity
- Utilization of Small, Small Disadvantaged, and Women-Owned Small Business Concerns
- Clean Air and Water
- Hazardous Material Identification and Material Safety Data
- Affirmative Action Compliance Requirements for Construction, Handicapped Workers, Special Disabled, and Vietnam Era Veterans
- Employment Reports on Special Disabled Veterans and Veterans of the Vietnam Era
- Convict Labor
- Utilization of Indian Organizations and Indian Owned Economic Enterprises
- Toxic Chemical Release Reporting
- Pollution Prevention and Right-to-Know Information

By what percentage does compliance with federal social action clauses raise your costs?

Circle the number of your answer for both types of contract. If compliance raises your costs by 8 percent or more, please specify the percentage. If either design or construction does not apply to you, please indicate "not applicable."

Type of contract	None	Less than 2%	2% to 4%	5% to 7%	8% or more (please specify)	Not applicable
Design	1	2	3	4	5(____%)	6
Construction	1	2	3	4	5(____%)	6

Cost Control And Accountability Clauses

Q-2. Examples of cost control and accountability clauses included in federal design and construction contracts are as follows:

- Audit and Records (Negotiations, Sealed Bidding)
- Price Reduction for Defective Cost or Pricing Data
- Subcontractor Cost or Pricing Data
- Cost Accounting Standards
- Disclosure and Consistency of Cost Accounting Practices
- Consistency in Cost Accounting Practices
- Administration of Cost Accounting Standards
- Assignments of Claims
- Value Engineering
- Improper Business Practices
- Contract Options
- Bid Guarantee
- Limitation of Government Liability
- Anti-Kickback Procedures
- Contract Definitization

By what percentage does compliance with federal cost control and accountability clauses raise your costs?

Circle the number of your answer for both types of contract. If compliance raises your costs by 8 percent or more, please specify the percentage. If either design or construction does not apply to you, please indicate "not applicable."

Type of contract	None	Less than 2%	2% to 4%	5% to 7%	8% or more (please specify)	Not applicable
Design	1	2	3	4	5(____%)	6
Construction	1	2	3	4	5(____%)	6

Business Protection Clauses

Q-3. Examples of business protection clauses included in federal design and construction contracts are as follows:

- Buy American Act—Construction Materials
- Buy American Act—Construction Materials Under Trade Agreements Act and North American Free Trade Agreement
- Data Rights
- Preference for Privately Owned U.S. Flag Commercial Vessels and Air Carriers

By what percentage does compliance with federal business protection clauses raise your costs?

Circle the number of your answer for both types of contract. If compliance raises your costs by 8 percent or more, please specify the percentage. If either design or construction does not apply to you, please indicate "not applicable."

Type of contract	None	Less than 2%	2% to 4%	5% to 7%	8% or more (please specify)	Not applicable
Design	1	2	3	4	5(____%)	6
Construction	1	2	3	4	5(____%)	6

Labor Statute Clauses

Q-4. Examples of labor statute clauses included in federal design and construction contracts are as follows:

- Fair Labor Standards Act
- Compliance with Davis–Bacon and Related Act Regulations
- Subcontracts and Outside Associates and Consultants
- Subcontracts (Fixed-Price Contracts, Cost-Reimbursement and Letter Contracts, Time-and-Materials and Labor-Hour Contracts)
- Subcontracts (Labor Standards)
- Miller Act
- Contract Work Hours and Safety Standards Act—Overtime Compensation
- Apprentices and Trainees
- Labor Standards for Construction Work—Facilities Contracts
- Compliance with Copeland Act Requirements
- Payrolls and Basic Records
- Disputes Concerning Labor Standards
- Certification of Eligibility
- Approval of Wage Rates
- Right of First Refusal of Employment

By what percentage does compliance with federal labor statute clauses raise your cost?

Circle the number of your answer for both types of contract. If compliance raises your costs by 8 percent of more, please specify the percentage. If either design or construction does not apply to you, please indicate "not applicable."

Type of contract	None	Less than 2%	2% to 4%	5% to 7%	8% or more (please specify)	Not applicable
Design	1	2	3	4	5(____%)	6
Construction	1	2	3	4	5(____%)	6

Other Requirements

Q-5. In addition to various social action and other clauses, federal design and construction contracts include restrictive technical specifications and restrictive material specifications. By what percentage does compliance with federal technical and material specifications raise your costs?

Circle the number of your answer for both types of contract. if compliance raises your costs by 8 percent or more, please specify the percentage. If either design or construction does not apply to you, please indicate "not applicable."

Type of contract	None	Less than 2%	2% to 4%	5% to 7%	8% or more (please specify)	Not applicable
Design	1	2	3	4	5(____%)	6
Construction	1	2	3	4	5(____%)	6

Background

Q-6. What were your firm's approximate total gross billings for your last fiscal year?

$_____

Q-7. Of your firm's total dollar volume of work, what percentage is done for the federal government?

_____%

Q-8. About how many employees are in your firm (include all offices)?

_____

Comments

Would you like to comment on your answers to any of the previous questions? If so, please use this space for that purpose.

ANNEX D-2. SURVEY RESPONSES

The following charts show the distribution of responses and the median response for each of the survey questions for both design costs and construction costs. Each chart shows the percentage of cost increase on the x-axis and the number of responses on the y-axis. For example, Chart 1 shows that 68 survey respondents indicated that social action clauses increase their design costs 1 percent.

Chart 1: Social Action Clauses—Design

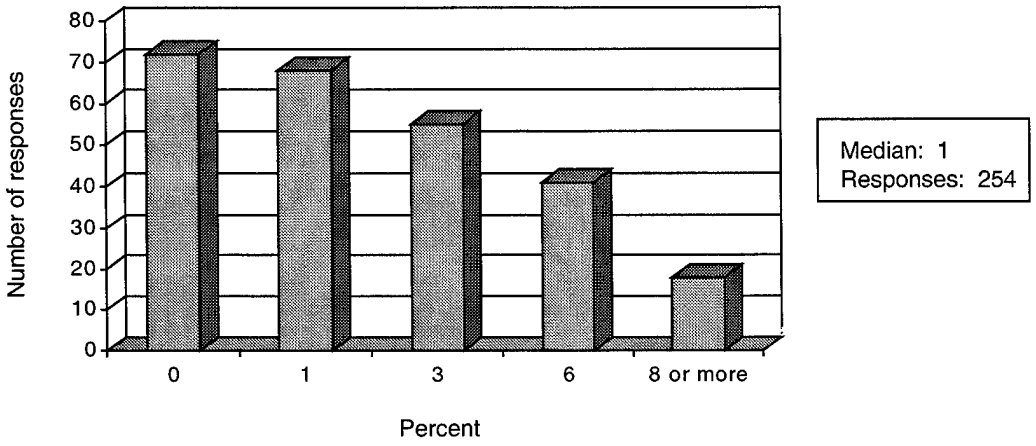


Chart 2: Social Action Clauses—Construction

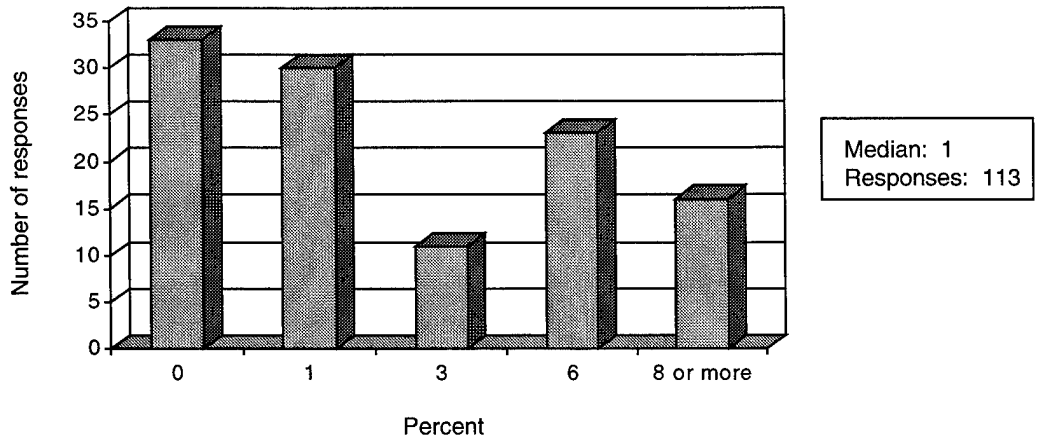


Chart 3: Cost Control and Accountability Clauses—Design

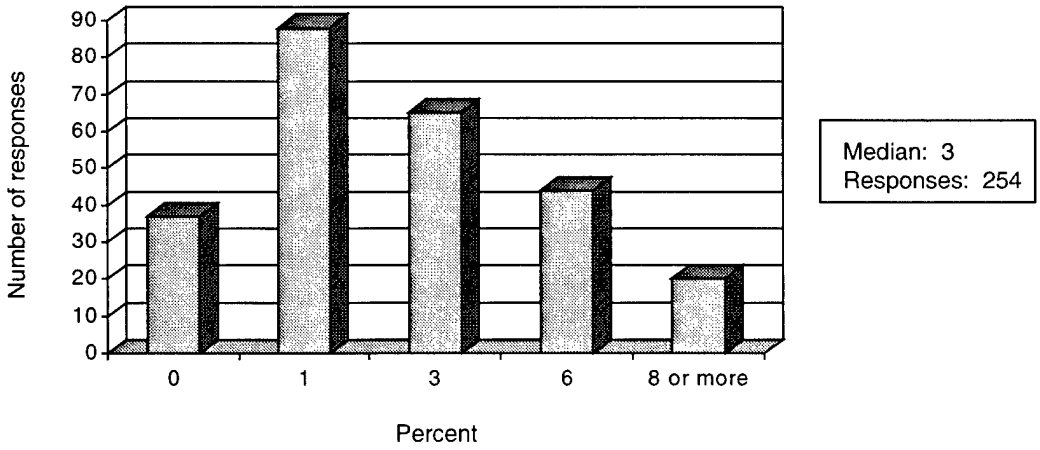


Chart 4: Cost Control and Accountability Clauses—Construction

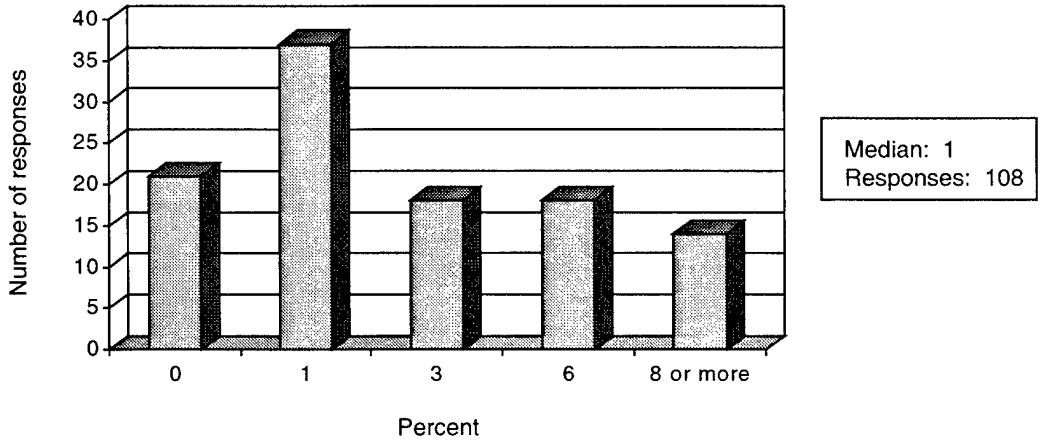


Chart 5: Business Protection Clauses—Design

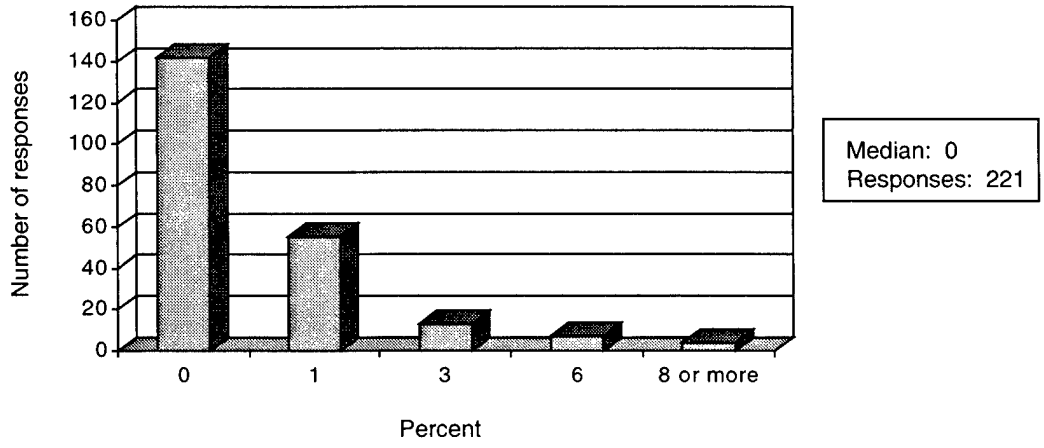


Chart 6: Business Protection Clauses—Construction

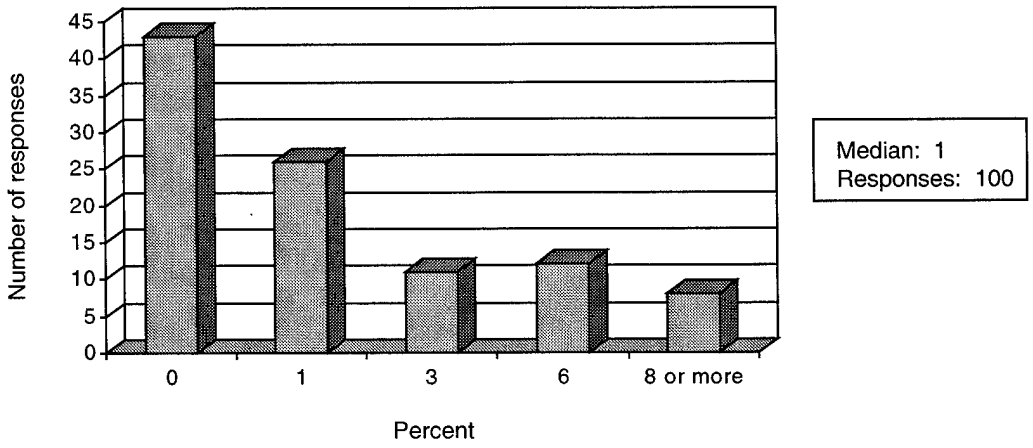


Chart 7: Labor Statute Clauses—Design

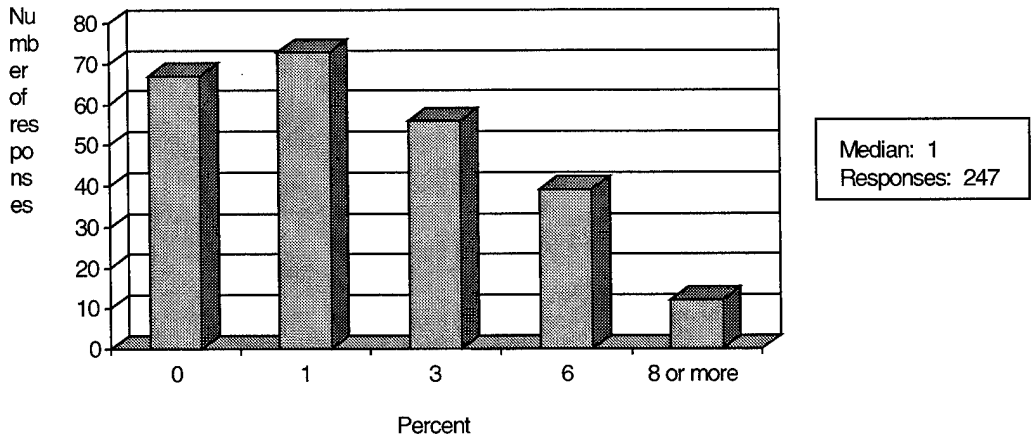


Chart 8: Labor Statute Clauses—Construction

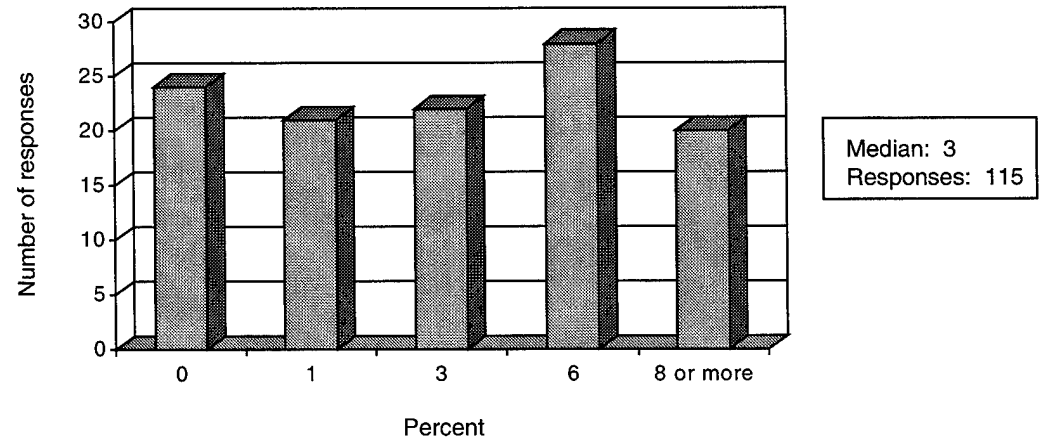


Chart 9: Other Requirements—Design

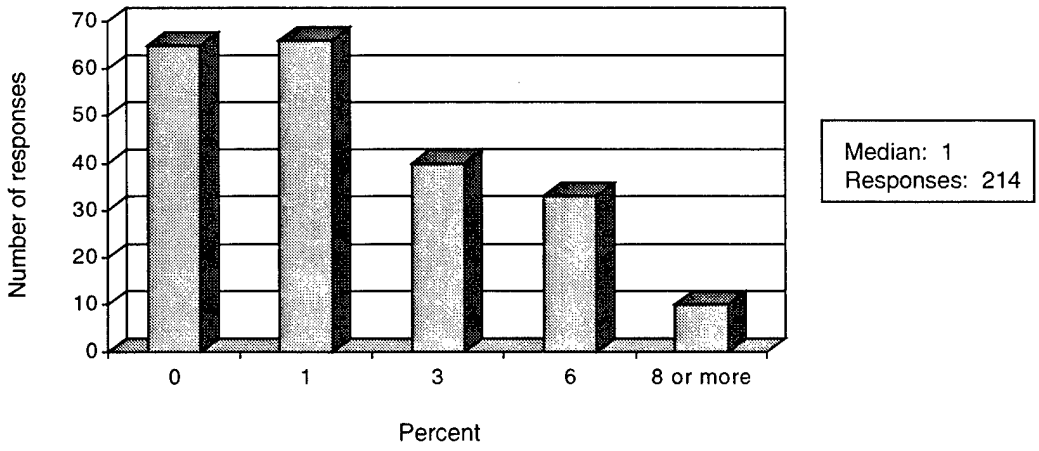
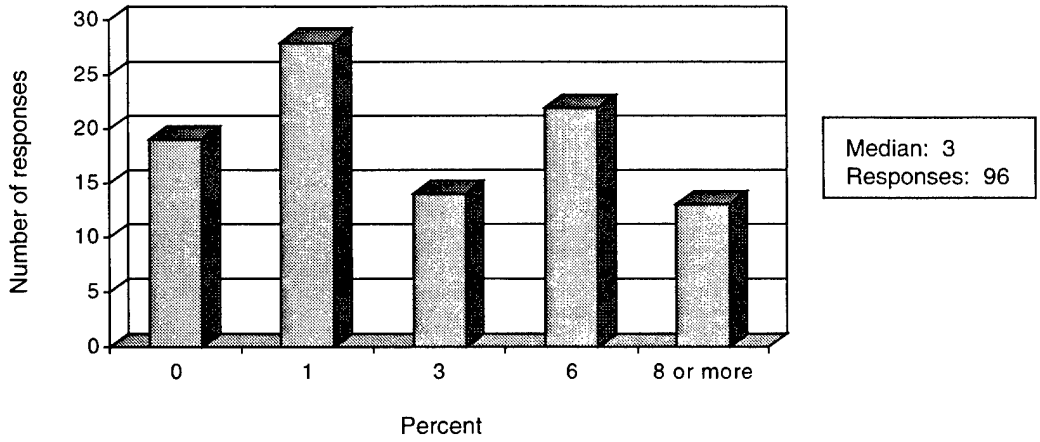


Chart 10: Other Requirements—Construction



ANNEX D-3. COMMENTS OF SURVEY RESPONDENTS

In this annex, we quote the comments made by the respondents to the ACEC survey.

- We are a design firm. Therefore, we only commented on design increases.
- The responses are for our design firm. I have not provided any answers for our design-build contractor partner.
- While the costs to our firm of the requirements are quite low, I think the cost to the project is quite high when the construction cost and factors like DBE and payroll reporting are counted.
- Bureaucrats cost too much money.
- Socio-economic clauses do not raise our costs. They preclude us from working on about 95 percent of the city of Portland (Oregon) and federal contracts because the MBE, WBE, HUB, SDB, etc., component is filled with a qualifying geotechnical firm. The truly galling aspects of the situation relate to general technical qualifications of the small minority, disadvantaged, women-owned busineses and the legitimacy of their qualifications as a disadvantaged firm. There should also be a length of time that a firm has this advantage. Maybe five years?
- State and county projects using federal funds have the same requirements.
- The cost to compete on the new design is about 10 to 15 times more expensive than quality based selection. This is driving up business development and overhead.
- A very disagreeable requirement not mentioned in this survey is federal audit requirement, which includes disallowance of some legitimate overhead, as well as caps on allowed profit and on compensation. This has an effect on our firm because we must work for 10 to 15 percent less than for private clients (using cost and fixed fee contract). This carries over to state work also, as state uses federal FAR requirements as a model.
- Utilization of small, small disadvantageous, and women-owned small businesses are the most erroneous of the federal requirements. We are a full service, all discipline EA firm and only need to subcontract very specialized portions of our work. To be forced to subcontract a substantial part of our work to other firms cuts into revenue and profit and has a negative impact on the quality of our services. This is a requirement of the federal government whose time has past. It has no need or relevance in today's market.

- As a DBE firm, I resent the implication that we are less efficient or cost the project more. We prime many projects, so we are familiar with the problems of subs, and find just as many problems with non DBEs as DBEs.
- The items listed on this questionaire are not significant to our company.
- We limit our practice to private property owners or Indian reservations.
- The laws do increase costs but in a small way compared to endless design iterations and extensive design reviews.
- The FAR requirements are most difficult for a small firm to segregate and comply with.
- We do our best not to be involved with government contracts.
- I do not believe our firm provides conclusive data for your survey due to our site and small percentage of federal government work overall.
- We avoid design assignments from federal agencies. Too much red tape.
- DCAA audits are a waste of time and money since federal agencies will not contract for actual rates and overhead but use some internal pressure to determine what your rates and overhead should be.
- Audit provisions are most restrictive and expensive to administer. Need to get rid of fees tied to salary and overhead and negotiate lump-sum no audit contracts.
- DBE requirement is a fiasco.
- Of the work we do for the federal government (which is not federal), the various clauses do not seem to affect the costs substantially if at all.
- The only pure federal government work that we do is for other professionals, so we do not know about their paperwork.
- DBEs should only be a requirement if they are qualified and if they are locally available. To go to Ohio to find a DBE for a construction testing job in North Carolina is wasteful.
- Federal programs are good for business but waste a lot of taxpayer money on foolish overregulation.
- Our engineering is not directly for the Fed, but all contracts, materials and procedures must follow RUS, USDA guidelines. We do not do construction.

- Federal regulations in federal grant and/or loan programs for clients have the greatest impact.
- Impact is not greater on construction than design. We usually increase cost estimates by 25 to 50 percent for federal construction projects, depending on the agency.
- Extensive paperwork results in considerably greater overhead activity. If more of our firm's work were for federal government, we would need to expand our finance group and contracts group.
- The most erroneous requirements have to do with affirmative action. As a subconsultant on a multidisciplined team, we are often either burdened with meeting an unreasonable percentage within our discipline or excluded from teams all together. So, the same MBE firm can get all the work. There are very few WOEs in our discipline but that is ignored.
- Restrictions/requirements should be "site specific" allowing qualified professionals to exercise good judgment.
- We see federal regulations through DOT at state but there is not enough impact to answer your questions.
- Elimination of Davis-Bacon is the best thing that could happen.

Appendix E
Private-Sector Construction Management Costs

INTRODUCTION

In contrast with the engineering industry, the U.S. construction management (CM) industry is relatively new. It has little data available to describe the fees charged for providing CM services. Until recently, few agreed on the services that constitute construction management. In response, the Construction Management Association of America (CMAA) published *Standard CM Services and Practices*, a manual that details the services constituting construction management. To collect data on the fees charged for CM services, CMAA has conducted a series of surveys, the first in 1989, with follow-up surveys in 1993, 1995, and 2000. This appendix briefly describes the 2000 survey and summarizes the results.

CMAA mailed the survey in March 2000 to 313 of its members—companies that perform CM functions. The surveys asked for descriptive data on each company as well as specific data on construction projects. Table E-1 shows the number of responses.

Table E-1. Number of Survey Responses

Category	Number
Companies mailed surveys	313
Valid company responses	19
Valid project responses	111

CHARACTERISTICS OF RESPONDENTS

Figure E-1 shows the distribution of valid company responses, classified by the company's predominant types of work. Forty-two percent of the respondents classified themselves as pure CM companies, 21 percent as a combination of general contractor (GC) and CM, and 32 percent as a combination of architect-engineer (A-E) and CM.

Figure E-1. Survey Respondent Distribution by Type of Company

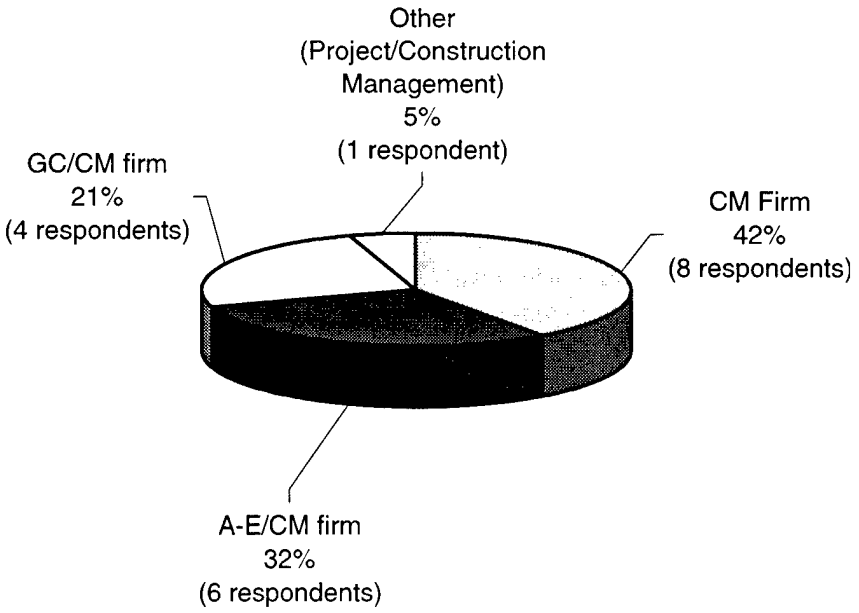


Figure E-2 shows the distribution of valid responses by total staff size. The companies were asked to give full-time equivalents for their part-time and consultant staffs. The responses were equally distributed respective to staff size: 53 percent of the responses were from smaller companies (50 or fewer employees) and 47 percent were from larger companies (51 or more employees).

Figure E-2. Survey Respondent Distribution by Company Size

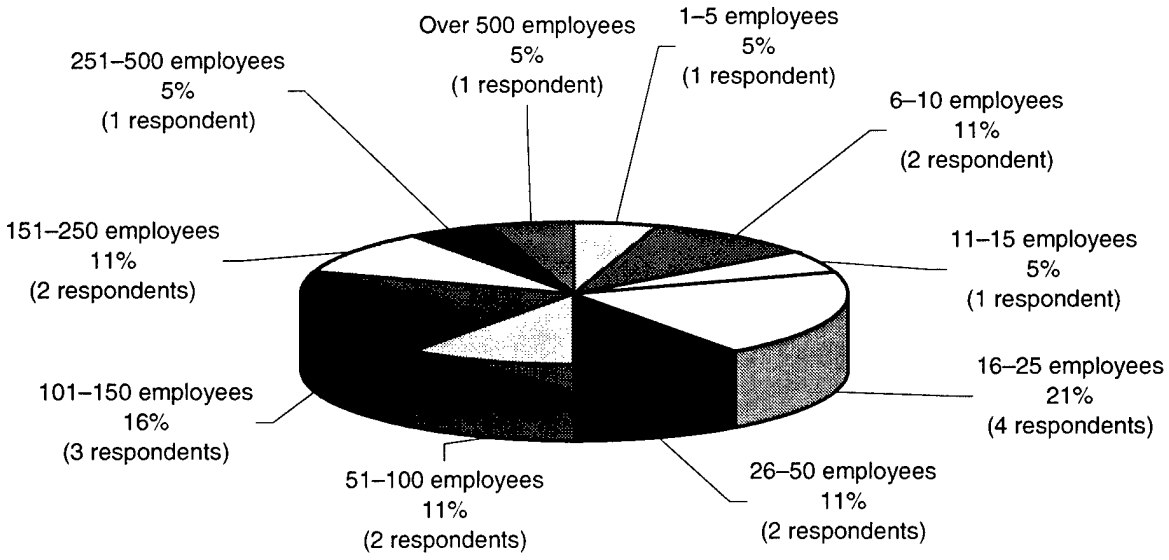


Figure E-3 shows the distribution of survey responses by clientele. Companies were classified as having either private-sector or government clientele if at least 75 percent of their contracts came solely from either of those sources; otherwise, they were called mixed.

Figure E-3. Survey Respondent Distribution by Clientele

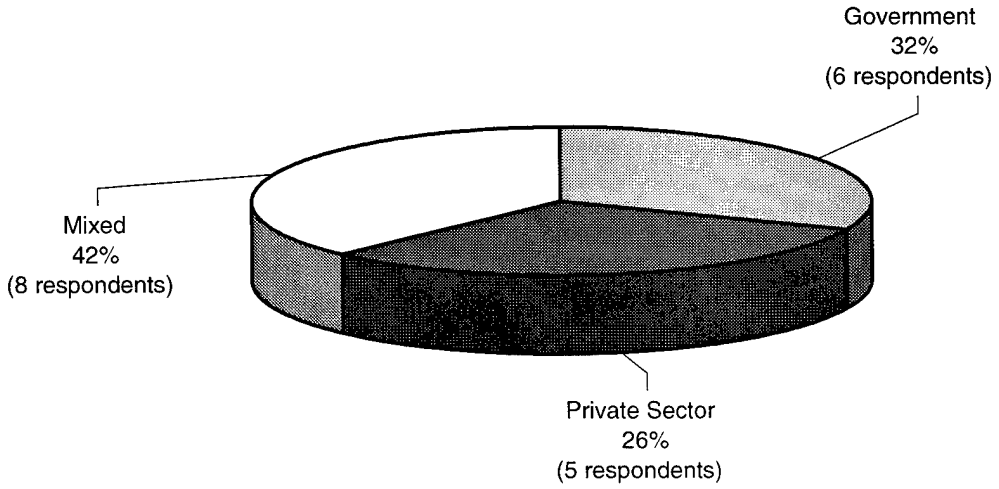


Table E-2 summarizes data on fees charged by CM companies. The "negotiated fixed fee" contract was the most popular type of fee structure; the "time spent" contract was second most popular.

Table E-2. Distribution of Fee Types Used by CM Companies (Percent)

Type	Mean
Negotiated fixed fee	30
Lump sum bid	6
Cost plus fixed fee	15
Time spent (with maximum or time and materials)	28
Percentage of construction contract	19
Other	1

Note: Percentages may not sum to 100 because of rounding.

Table E-3 summarizes data on CM companies' customers. Most CM work is for educational/institutional clients, state and local government clients, and corporate/administrative/commercial clients.

Table E-3. Distribution of Customer Types Served by CM Companies (percent)

Type	Mean
Health care providers	5
Corporate/industrial	7
Housing/lodging	6
Commercial developers	8
Corporate/administrative/commercial	13
Educational/institutional	20
Private religious/cultural	4
State and local government	20
Environmental Protection Agency	0
Transportation departments	12
Department of Defense	3
Other federal	0

Note: Percentages may not sum to 100 because of rounding.

DIRECT AND INDIRECT COST DATA

Table E-4 summarizes direct and indirect costs as a percentage of total CM revenues; it also shows annual operating income as a percentage of CM revenues. The data shown are the 25th percentile, the median, and the 75th percentile for all valid responses. The data are analyzed by size (number of employees) and type of company. As would be expected, the way each company allocated its costs varied widely. However, the median responses from participants indicate that they tend to allocate about 34 percent of their costs to direct labor, 9 percent to payroll burden, 6 percent to general and administrative (G&A) labor expenses, 7 percent to G&A nonlabor expenses, and 4 percent to nonlabor direct expenses (the allocation of CM costs is *not* intended as guidance). Since accounting practices vary among participants, it is difficult to draw conclusions from these results. The median annual operating income as a percentage of CM revenues is 14 percent, with small variations by the size and type of company.

Table E-4. Summary of CM Costs and Annual Operating Income As a Percentage of CM Revenues

Type	Size of firm		Type of firm			Overall
	1–15 emp. (4 firms)	>15 emp. (15 firms)	CM (9 firms)	GC/CM (4 firms)	A-E/CM (6 firms)	
Direct labor cost						
25th	26	9	34	5	20	9
Median	37	34	35	9	33	34
75th	47	38	39	18	38	38
Payroll burden						
25th	15	3	7	2	2	3
Median	22	7	14	3	8	9
75th	24	13	21	6	11	15
G&A labor cost						
25th	8	4	7	3	1	4
Median	11	5	12	5	5	6
75th	25	11	25	5	9	12
G&A nonlabor cost						
25th	6	2	7	0	1	2
Median	9	6	11	1	4	7
75th	10	16	13	8	13	14
Nondirect labor cost						
25th	0	0	1	0	9	0
Median	3	4	4	0	13	4
75th	11	12	5	0	30	12
Annual operating income						
25th	8	4	6	1	4	4
Median	11	6	11	11	15	14
75th	14	21	18	34	17	20

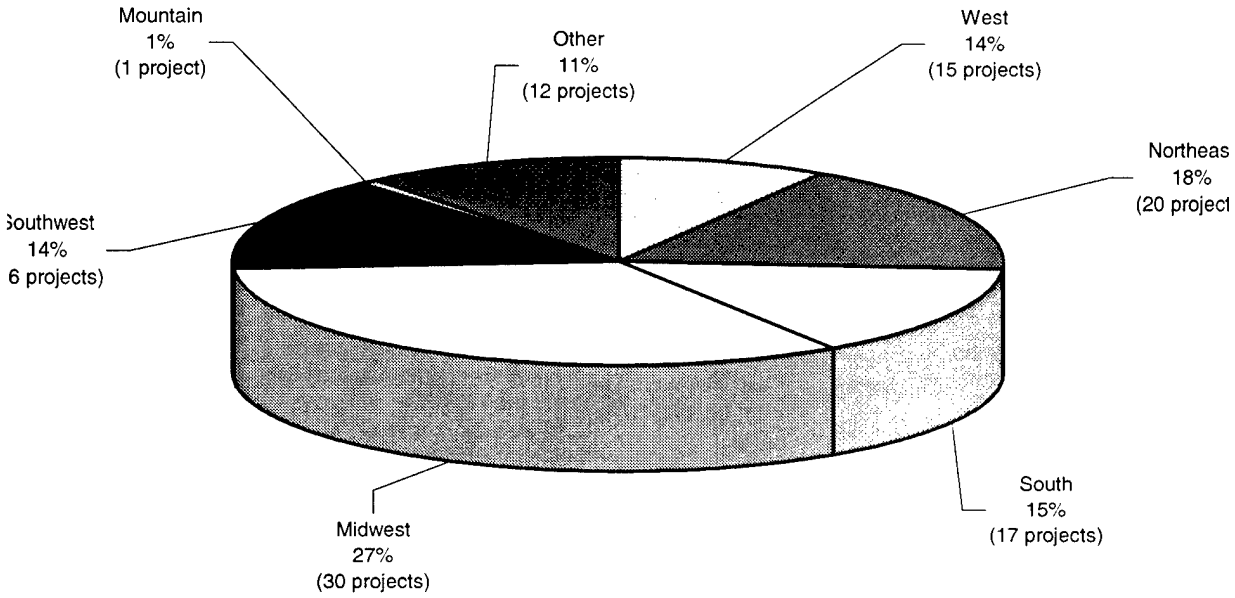
INDIVIDUAL CONSTRUCTION PROJECT DATA

Respondents were asked to submit information on as many as six construction projects for which their companies had performed CM services. The survey asked for type of construction project, project location, scope of the project (i.e., new construction or renovation), type of contract (CM as owner's agent or CM providing guaranteed maximum price), the basis for internally estimating the CM contract value, and the value of both the CM and construction contracts.

Figure E-4 shows the distribution of the 111 projects by geographic location. (Location affects the cost of services provided.) This survey indicates that CMAA members are performing most of their CM work in the Midwest. A great deal of work is also being done in the Northeast, South, and Southwest. In addition,

several CMAA members are performing their work outside of the United States, in Canada, Puerto Rico, and the Virgin Islands. These results are strongly a function of the type of CM companies that participated and should not be interpreted as a major industry trend.

Figure E-4. Regional Distribution of Construction Projects



Note: The regions are defined as follows:

Region	State
Northeast	CT, DE, MA, MD, ME, NH, NJ, PA, RI, VT
South	AL, AR, DC, FL, GA, KY, LA, MS, NC, SC, TN, VA, WV
Midwest	IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI
Southwest	AZ, NM, OK, TX
Mountain	CO, ID, MT, NV, WY, UT
West	AK, CA, HI, OR, WA
Other	Canada, Puerto Rico, Virgin Islands

Table E-5 shows the distribution of the 111 projects by category and project type. The categories are groups of similar types of projects.

Table E-5. Distribution of Projects by Category and Project Type

Category and project type	Number of projects	Percentage of total
Health care providers		
(01) Hospitals	2	1.8
(03) Clinics/outpatient facilities	1	0.9
(04) Medical offices	3	2.7
(05) Extended care/nursing homes	1	0.9
Subtotal	7	6.3
Corporate/industrial		
(06) Warehouse/distribution centers	6	5.4
(07) Light industrial	0	0.0
(08) Process plants/heavy industrial	0	0.0
Subtotal	6	5.4
Housing/lodging		
(09) Hotels (high rise)	1	0.9
(10) Motels (low rise)	0	0.0
(11) Apartments/condominiums (low rise)	0	0.0
(12) Apartments/condominiums (high rise)	2	1.8
(13) Single family housing	6	5.4
Subtotal	9	8.1
Commercial developers		
(14) High rise office building	0	0.0
(15) Mid rise office building	1	0.9
(16) Low rise office building	0	0.0
(17) Shopping malls (enclosed)	4	3.6
(18) Strip shopping centers	2	1.8
Subtotal	7	6.3
Corporate/administrative/commercial		
(19) General offices	10	9.0
(20) Retail stores	0	0.0
(21) Restaurants	1	0.9
Subtotal	11	9.9
Educational/institutional		
(22) Classrooms	22	19.8
(23) Science/research labs	0	0.0
(24) Dormitories/housing	1	0.9
(25) Sports/athletic facilities	6	5.4
Subtotal	29	26.1

Table E-5. Distribution of Valid Responses by Project Type (Continued)

Category and project type	Number of projects	Percentage of total
Private religious/cultural		
(26) Churches	5	4.5
(27) Theaters/auditoriums	3	2.7
Subtotal	8	7.2
State and local government		
(28) Office buildings	4	3.6
(29) Museums/galleries	2	1.8
(30) Correctional facilities	3	2.7
Subtotal	9	8.1
Environmental Protection Agency		
(31) Water treatment plants	1	0.9
(32) Wastewater treatment	1	0.9
(33) Hazardous waste facilities	0	0.0
(34) Water/sewer lines	0	0.0
Subtotal	2	1.8
Transportation departments		
(35) Bridges	6	5.4
(36) Roads	11	9.9
(37) Tunnels	0	0.0
(38) Airports	6	5.4
Subtotal	23	20.7
Department of Defense		
(39) Military housing	0	0.0
(40) Military offices	0	0.0
(41) Military training facilities	0	0.0
(42) Military medical facilities	0	0.0
(43) Piers/wharves	0	0.0
(44) Dredging	0	0.0
(45) Locks and dams	0	0.0
(46) Reservoirs	0	0.0
(47) Channel protection	0	0.0
(48) Beach stabilization	0	0.0
Subtotal	0	0.0
Other federal		
(49) Office buildings	0	0
(50) Postal buildings	0	0
Subtotal	0	0.0
Total	111	99.9

Note: Percentages do not add to 100 because of rounding. The two-digit number in parentheses is the CMAA project type.

Table E-6 shows the 25th percentile, median, and 75th percentile of the CM fees as a percentage of the cost of the construction contract for all projects by size of company, type of company, and client base. The table indicates that a relationship may exist between the CM fee and the size of the company. The highest CM fee is associated with the smallest company size (1–5 employees), and the second lowest CM fee is charged by the largest companies (more than 500 employees). However, the relationship is not very strong. For example, the largest category has the greatest variation in fee (1.9 percent in the 25th percentile and 10.0 percent in the 75th percentile) and all of the projects in both the largest and smallest categories come from a single firm. Therefore we cannot reach any definitive conclusions linking CM fee to size. The table also indicates that the A-E/CM companies charge higher fees than the GC and CM companies. This is likely due to the greater range of services the A-E/CM firms provide, particularly during predesign and design phases of a construction project. Also, CM companies providing services for the government are doing so at a lower cost than those providing services primarily for the private sector.

Table E-7 summarizes the CM services that survey participants provided during each construction project. In addition, the table shows the relative weight associated with each phase of CM as it relates to the total cost of the CM contract. The results indicate that the level of service in the predesign phase has decreased from that provided during the 1993 and 1995 surveys. However, the level of service for the design and bid phase, construction phase, and additional services is more or less comparable to the prior surveys.

Table E-6. Summary of Construction Management Fees As a Percentage of Construction Contract Cost

Item	CM fee (%)			Number of projects	Number of companies
	25th	Median	75th		
1993—overall	3.5	5.0	7.1	187	33
2000—overall	2.9	4.6	7.5	91[a]	18[a]
Size of company (number of employees)					
1–5	17.3	18.2	19.7	6	1
6–10	3.3	4.1	5.8	11	2
11–15	4.2	4.9	6.3	6	1
16–25	2.6	3.4	7.0	24	4
26–50	5.9	8.5	9.7	4	2
51–100	0.6	0.7	1.7	5	1
101–150	4.5	5.0	8.4	12	3
151–250	2.6	3.3	3.6	12	2
251–500	5.0	6.6	7.3	6	1
Over 500	1.9	3.1	10.0	5	1
Type of company					
CM firm	2.7	4.1	6.0	43	8
GC/CM firm	3.3	3.6	5.0	13	4
A-E/CM firm	4.0	7.2	12.0	29	5
Other	2.7	2.8	4.4	6	1
Client base					
Government	2.6	4.3	5.7	28	5
Private sector	3.3	4.8	10.0	25	5
Mixed	2.9	4.8	8.5	38	8

[a] Two companies did not provide fee/project information, and we excluded several projects because of inaccuracies in the data provided.

Table E-7. Distribution of Fee by Phase(Percent)

CM service	2000	1995	1993
Predesign phase	3.1	7.3	6.5
Design and bid phase	10.9	11.5	13.7
Construction phase	81.4	75.9	81.7
Additional services	5.6	8.6	2.9

Table E-8 shows service frequency by phase type.

Table E-8. Service Frequency by Phase (Percent)

CM service	2000	1995	1993
Predesign phase			
Project management	44	41	56
Scheduling	45	51	63
Cost management	45	47	59
Contract/project administration	39	50	56
Design and bid phase			
Project management	62	63	69
Scheduling	73	67	74
Cost estimating	64	68	72
Constructibility review	52	53	64
Quality assurance	35	44	47
Contract/project administration	51	59	66
Construction phase			
Project management	90	76	90
Scheduling	88	77	89
Cost management	93	74	91
Quality assurance	90	79	84
Contract/project administration	85	77	93
Additional services			
Procurement of materials	30	25	17
Value engineering	37	33	40
Materials testing	20	15	14
Claims analysis	23	18	14
Other	10	8	20

PROJECT STATISTICS SUMMARIES

Tables E-9 through E-17 provide the following information for nine of the construction categories listed in Table E-5 (we received no project information on the three categories omitted):

- *CM fee as a percentage of construction cost.* We show the CM fees as a percentage of construction cost for the following:
  - All projects
  - Projects for which CM acts as owner's agent
  - Projects for which CM provides guaranteed maximum price
  - Renovation projects
  - New construction projects.
- For each, we present the 25th percentile, median, and 75th percentile; the number of individual projects analyzed; and the number of different companies providing the project information so that the reader can see whether the information provided is unique to either single or multiple companies. The CM fee ranges indicate what industry members are charging for services provided and can be used as the starting point for determining an appropriate CM fee for the various types of construction and conditions. NA indicates that too few data points were available to calculate statistics.
- *Average values of construction and CM contracts.* We show the average value of the construction and CM contracts used in the CM fee analysis.
- *Basis for estimating CM contract value.* We show the methods used by the participants in the survey to determine the fee: percentage of construction contract value, direct and indirect cost calculation, or other.
- *Summary of CM services.* We show the CM services provided for the reported projects. The types of services are defined in CMAA's *Standard CM Services and Practices*. This list is intended to show the likelihood of the various types of services for each of the construction management categories and in no way attempts to define a cost associated with each service provided.

Table E-9. Health Care Providers

CM Fee As a Percentage of Construction Cost					
Project type	CM fee (%)			Number of projects	Number of companies
	25th	Median	75th		
Overall fee	6.6	9.3	10.9	4	3
CM as owners agent	10.9	11.1	11.3	2	1
CM provides guaranteed maximum price	3.9	3.9	6.6	2	2
Renovation	NA	NA	NA	0	0
New construction	6.6	9.3	10.9	4	3

Average Values of Construction and CM Contracts	
Construction contract	$3,144,000
CM contract	$157,500

Basis for Estimating CM Contract Value	
Percentage of construction contract value	50%
Direct and indirect cost calculation	50%
Other	0%

Summary of CM Services		
Services provided	Percentage of respondents performing service	Distribution of phase costs (%)
Predesign phase		3.7
Project management	75	
Scheduling	75	
Cost management	75	
Contract/project administration	75	
Design and bid phase		6.2
Project management	100	
Scheduling	100	
Cost estimating	100	
Constructibility review	50	
Quality assurance	25	
Contract/project administration	50	
Construction phase		90.0
Project management	100	
Scheduling	100	
Cost management	100	
Quality assurance	100	
Contract/project administration	100	
Additional services		0
Procurement of materials	0	
Value engineering	0	
Materials testing	0	
Claims analysis	0	
Other	0	

Table E-10. Corporate/Industrial

CM Fee As a Percentage of Construction Cost					
Project type	CM fee (%)			Number of projects	Number of companies
	25th	Median	75th		
Overall fee	2.9	3.8	7	5	3
CM as owners agent	2.9	3.8	7	5	3
CM provides guaranteed maximum price	NA	NA	NA	0	0
Renovation	NA	NA	NA	0	0
New construction	2.9	3.8	7	5	3

Average Values of Construction and CM Contracts	
Construction contract	$5,600,000
CM contract	$219,000

Basis for Estimating CM Contract Value	
Percentage of construction contract value	0%
Direct and indirect cost calculation	100%
Other	0%

Summary of CM Services		
Services provided	Percentage of respondents performing service	Distribution of phase costs (%)
Predesign phase		3.0
Project management	50	
Scheduling	50	
Cost management	50	
Contract/project administration	50	
Design and bid phase		4.8
Project management	75	
Scheduling	75	
Cost estimating	75	
Constructibility review	50	
Quality assurance	0	
Contract/project administration	75	
Construction phase		90.8
Project management	100	
Scheduling	100	
Cost management	100	
Quality assurance	100	
Contract/project administration	100	
Additional services		1.2
Procurement of materials	50	
Value engineering	50	
Materials testing	0	
Claims analysis	0	
Other	0	

Table E-11. Housing/Lodging

CM Fee As a Percentage of Construction Cost					
Project type	CM fee (%)			Number of projects	Number of companies
	25th	Median	75th		
Overall fee	4.0	16.5	17.6	9	5
CM as owners agent	4.5	16.8	17.9	8	4
CM provides guaranteed maximum price	NA	4.0	NA	1	1
Renovation	16.7	17.4	18.5	6	2
New construction	2.2	2.9	3.9	3	3
Average Values of Construction and CM Contracts					
Construction contract				$8,563,889	
CM contract				$263,188	
Basis for Estimating CM Contract Value					
Percentage of construction contract value				56%	
Direct and indirect cost calculation				22%	
Other				22%	
Summary of CM Services					
Services provided	Percentage of respondents performing service			Distribution of phase costs (%)	
Predesign phase				2.0	
Project management	22				
Scheduling	33				
Cost management	33				
Contract/project administration	22				
Design and bid phase				8.9	
Project management	22				
Scheduling	78				
Cost estimating	78				
Constructibility review	11				
Quality assurance	11				
Contract/project administration	78				
Construction phase				69.4	
Project management	100				
Scheduling	100				
Cost management	100				
Quality assurance	100				
Contract/project administration	89				
Additional services				19.7	
Procurement of materials	67				
Value engineering	22				
Materials testing	22				
Claims analysis	22				
Other	11				

Table E-12. Commercial Developers

CM Fee As a Percentage of Construction Cost					
Project type	CM fee (%)			Number of projects	Number of companies
	25th	Median	75th		
Overall fee	3.3	3.5	4.3	6	4
CM as owners agent	2.9	4.5	7.3	3	3
CM provides guaranteed maximum price	3.3	3.3	3.5	3	1
Renovation	NA	3.3	NA	1	1
New construction	3.3	3.6	4.5	5	4

Average Values of Construction and CM Contracts	
Construction contract	$22,333,333
CM contract	$995,716

Basis for Estimating CM Contract Value	
Percentage of construction contract value	50%
Direct and indirect cost calculation	33%
Other	17%

Summary of CM Services		
Services provided	Percentage of respondents performing service	Distribution of phase costs (%)
Predesign phase		1.8
Project management	33	
Scheduling	33	
Cost management	33	
Contract/project administration	33	
Design and bid phase		6.3
Project management	100	
Scheduling	100	
Cost estimating	100	
Constructibility review	33	
Quality assurance	33	
Contract/project administration	50	
Construction phase		90.2
Project management	100	
Scheduling	100	
Cost management	100	
Quality assurance	100	
Contract/project administration	100	
Additional services		1.7
Procurement of materials	0	
Value engineering	0	
Materials testing	17	
Claims analysis	0	
Other	0	

Table E-13. Corporate/Administrative/Commercial

CM Fee As a Percentage of Construction Cost					
Project type	CM fee (%)			Number of projects	Number of companies
	25th	Median	75th		
Overall fee	3.4	5.6	7.1	11	5
CM as owners agent	3.4	5.6	7.1	11	5
CM provides guaranteed maximum price	NA	NA	NA	0	0
Renovation	4.9	6.4	7.5	5	3
New construction	2.7	4.2	6.4	6	4

Average Values of Construction and CM Contracts	
Construction contract	$5,391,455
CM contract	$193,209

Basis for Estimating CM Contract Value	
Percentage of construction contract value	20%
Direct and indirect cost calculation	30%
Other	50%

Summary of CM Services		
Services provided	Percentage of respondents performing service	Distribution of phase costs (%)
Predesign phase		6.5
Project management	91	
Scheduling	82	
Cost management	82	
Contract/project administration	73	
Design and bid phase		20.6
Project management	91	
Scheduling	100	
Cost estimating	91	
Constructibility review	45	
Quality assurance	18	
Contract/project administration	36	
Construction phase		65.0
Project management	100	
Scheduling	91	
Cost management	100	
Quality assurance	91	
Contract/project administration	55	
Additional services		7.9
Procurement of materials	36	
Value engineering	36	
Materials testing	18	
Claims analysis	18	
Other	45	

Table E-14. Educational/Institutional

CM Fee As a Percentage of Construction Cost					
Project type	CM fee (%)			Number of projects	Number of companies
	25th	Median	75th		
Overall fee	2.5	3.4	4.4	22	11
CM as owners agent	2.4	3.4	4.2	16	7
CM provides guaranteed maximum price	3.2	4.2	6.8	6	3
Renovation	4.2	4.5	5.7	8	5
New construction	2.0	2.6	3.7	14	9

Average Values of Construction and CM Contracts	
Construction contract	$78,484,500
CM contract	$1,521,627

Basis for Estimating CM Contract Value	
Percentage of construction contract value	23%
Direct and indirect cost calculation	68%
Other	9%

Summary of CM Services		
Services provided	Percentage of respondents performing service	Distribution of phase costs (%)
Predesign phase		2.9
Project management	59	
Scheduling	59	
Cost management	59	
Contract/project administration	53	
Design and bid phase		10.7
Project management	76	
Scheduling	88	
Cost estimating	71	
Constructibility review	76	
Quality assurance	53	
Contract/project administration	65	
Construction phase		83.1
Project management	60	
Scheduling	94	
Cost management	100	
Quality assurance	94	
Contract/project administration	100	
Additional services		3.0
Procurement of materials	67	
Value engineering	100	
Materials testing	25	
Claims analysis	33	
Other	8	

Table E-15. Private Religious/Cultural

CM Fee As a Percentage of Construction Cost					
Project type	CM fee (%)			Number of projects	Number of companies
	25th	Median	75th		
Overall fee	1.7	2.2	4.8	5	5
CM as owners agent	1.4	1.9	2.8	4	4
CM provides guaranteed maximum price	NA	4.8	NA	1	1
Renovation	NA	NA	NA	0	0
New construction	1.7	2.2	4.8	5	5

Average Values of Construction and CM Contracts	
Construction contract	$43,800,000
CM contract	$749,600

Basis for Estimating CM Contract Value	
Percentage of construction contract value	0%
Direct and indirect cost calculation	80%
Other	20%

Summary of CM Services		
Services provided	Percentage of respondents performing service	Distribution of phase costs (%)
Predesign phase		4.4
Project management	25	
Scheduling	50	
Cost management	50	
Contract/project administration	25	
Design and bid phase		9.2
Project management	50	
Scheduling	25	
Cost estimating	25	
Constructibility review	75	
Quality assurance	50	
Contract/project administration	25	
Construction phase		82.8
Project management	100	
Scheduling	75	
Cost management	100	
Quality assurance	100	
Contract/project administration	100	
Additional services		4.6
Procurement of materials	25	
Value engineering	50	
Materials testing	25	
Claims analysis	25	
Other	0	

Table E-16. State and Local Government

CM Fee As a Percentage of Construction Cost					
Project type	CM fee (%)			Number of projects	Number of companies
	25th	Median	75th		
Overall fee	5.0	7.9	10.8	6	5
CM as owners agent	4.6	6.0	9.9	5	4
CM provides guaranteed maximum price	NA	14.0	NA	1	1
Renovation	NA	6.0	NA	1	1
New construction	4.6	9.9	11.1	5	4

Average Values of Construction and CM Contracts	
Construction contract	$57,500,000
CM contract	$2,347,667

Basis for Estimating CM Contract Value	
Percentage of construction contract value	17%
Direct and indirect cost calculation	50%
Other	33%

Summary of CM Services		
Services provided	Percentage of respondents performing service	Distribution of phase costs (%)
Predesign phase		1.5
Project management	33	
Scheduling	33	
Cost management	33	
Contract/project administration	33	
Design and bid phase		8.2
Project management	17	
Scheduling	17	
Cost estimating	0	
Constructibility review	33	
Quality assurance	17	
Contract/project administration	17	
Construction phase		88.2
Project management	100	
Scheduling	83	
Cost management	100	
Quality assurance	100	
Contract/project administration	83	
Additional services		2.2
Procurement of materials	50	
Value engineering	50	
Materials testing	0	
Claims analysis	0	
Other	0	

Table E-17. Transportation Departments

CM Fee As a Percentage of Construction Cost					
Project type	CM fee (%)			Number of projects	Number of companies
	25th	Median	75th		
Overall fee	4.5	6.6	7.7	16	8
CM as owners agent	4.0	5.4	7.5	13	6
CM provides guaranteed maximum price	NA	NA	NA	0	0
Renovation	7.0	7.5	7.7	4	3
New construction	2.7	4.3	7.6	8	4
Average Values of Construction and CM Contracts					
Construction contract				$415,798,813	
CM contract				$23,070,000	
Basis for Estimating CM Contract Value					
Percentage of construction contract value				0%	
Direct and indirect cost calculation				100%	
Other				0%	

Summary of CM Services		
Services provided	Percentage of respondents performing service	Distribution of phase costs (%)
Predesign phase		1.9
Project management	25	
Scheduling	25	
Cost management	25	
Contract/project administration	25	
Design and bid phase		11.1
Project management	63	
Scheduling	75	
Cost estimating	69	
Constructibility review	81	
Quality assurance	63	
Contract/project administration	63	
Construction phase		82.2
Project management	88	
Scheduling	100	
Cost management	100	
Quality assurance	100	
Contract/project administration	100	
Additional services		4.4
Procurement of materials	0	
Value engineering	31	
Materials testing	44	
Claims analysis	56	
Other	0	

Appendix F
Comparative Analysis of Army and Private-Sector Construction Costs

This appendix examines differences between MILCON and private-sector construction costs for three categories of projects:

- Family housing
- Barracks
- Administrative space.

We begin with a brief discussion of the method used to make the comparison. We then present the results by construction category, then present factors explaining the cost differences.

METHODOLOGY

Approach and Data Sources

We collected construction cost data for seven installations:

- Fort Bragg
- Fort Meade
- Fort Richardson
- Fort Lewis
- Fort Sam Houston
- Fort Drum
- Fort Hood.

We derived Army per-square-foot cost estimates using data from DoD's Tri-Service Committee on Cost Engineering and compared the estimates for each project category at each installation with data obtained from two commercial sources: Dodge and R.S. Means. We adjusted the Tri-Service cost estimates downward by 9 percent to account for the higher costs associated with federal

government contracts. (See Appendix D for methodology and cost factors we considered to derive the cost adjustments.)

We grouped the Dodge data, derived from a database that included all construction projects collected by the organization, by category and geographic area near each of the seven Army facilities. We computed median values (that is, the square foot cost that represents 50 percent of all projects by category and location above and below this value) for each facility. We excluded from the Dodge data per square foot values considered to be unreasonably low or high as not representative of the Army projects.

The R.S. Means data represent construction costs (excluding site preparation) for each of the categories that represent typical Army projects. For example, family housing costs per square foot are based on one-story detached housing with 1,400 square feet.

Location Adjustment

Construction costs vary by location. These cost differences are primarily attributable to labor cost differentials. However, differences in the cost of material delivered on site also explain part of the variation. For example, the cost of materials is higher in Alaska than in most other locations because of high shipping charges.

The three data sources applied—Tri-Service, Dodge, and R.S. Means—derive their national average costs per square foot from local area data. Construction cost data for each local area are subsequently compared to the national average to derive a local to national average index. In high cost areas such as Alaska or New York City, the index will exceed 1, while in lower cost cities, the index will be below 1. Local adjustment factors for specific locations such as Fort Richardson differ with each of our data sources. These differences are attributable to several factors. For example, the Tri-Service data are limited to DoD projects. Both R.S. Means and Dodge data are based on all private- and public-sector projects. In addition, the methods used to obtain cost estimates vary somewhat. For this project, we applied Tri-Service local area adjustment factors to the R.S. Means national data.

RESULTS BY CONSTRUCTION CATEGORY

Family Housing

As shown in Table F-1, the Army's average cost for construction of family housing at the seven installations in this study is $71.[1] By comparison, the Dodge

[1] We used the Tri-Service costs factors as the primary source of our data. We then adjusted those costs to account for the differences in costs at the seven Army posts. We also adjusted the costs to account for the contractors' costs of complying with legal and federal regulatory requirements.

mean for the seven installations is $59. Thus, the Tri-Service estimate is 20 percent higher than the Dodge estimate. However, the Dodge data for detached housing are based on estimated costs by builders/developers applying for building permits to local authorities. These submitted values are frequently lower than actual construction costs. Typically, certain fees and charges are based on these estimated costs. Therefore, there is an incentive to estimate costs at the low end of the cost spectrum. In addition, the Dodge data include all housing construction. We could not disaggregate the Dodge data to include only projects that are representative of military family housing.

The R.S. Means data shown in Table F-1 are for average quality one-story, 1,400-square-foot detached housing units without a basement or garage. The mean cost for the seven installations is $75 per square foot.

Table F-1. Construction Cost Comparison: Army vs. Private Sector (dollars per square feet)

Facility type	Army[a]	Private sector[b]	
		F.W. Dodge	R.S. Means
Family housing	71	59	75
Barracks/dormitories	116	99	100
Administrative buildings	104	83	91

Notes:
[a] Source: DoD's 1999 Tri-Service Cost Estimate.
[b] Sources: (1) F.W. Dodge Construction Costs, 1994 through 1999. (2) R.S. Means Construction costs, 1999.

The average R.S. Means cost for the seven locations ($75) is slightly higher than the Tri-Service cost, while the Dodge costs are significantly lower. However, we can discount the Dodge data because the information is not based on actual construction cost. Thus, the Means cost data is the most relevant. Those data suggest that when regulatory costs associated with government projects are excluded, Army family housing costs per square foot are very close to private-sector costs.

Barracks

To compare the cost of barracks with private-sector costs, we used college dormitories as a proxy. The adjusted average Tri-Service cost for barracks nationally is $116 per square foot, the same value as the Tri-Service mean for the seven installations (see Table F-1). This compares to a Dodge weighted average of $99 for the seven facilities based on all college dormitory construction. The R.S. Means estimate for dormitories, based on a composite of 2–3 story and 4–8 story 90,000-square-foot dormitories with a concrete frame and brick facing, is $100 per square foot, somewhat lower than the cost of Tri-Service barracks. Average Tri-Service costs are about 17 percent above the Dodge estimate and 16 percent above the R.S. Means estimate.

Administrative Space

For administrative buildings, the weighted average and adjusted Army cost is estimated at $104 per square foot (see Table F-1). These costs are 25 percent above Dodge costs of $83. However, as noted earlier, the Dodge data cannot be disaggregated to obtain projects similar to those typically constructed by the Army.

R.S. Means average costs per square foot for the seven areas are $91. These data indicate that Tri-Service costs are about 14 percent higher than similar buildings based on R.S. Means national construction data.

FACTORS EXPLAINING COST DIFFERENCES

Location Adjustment

We applied Tri-Service location adjustment factors to R.S. Means national data. In general, we have more confidence in R.S. Means data than in the Dodge data because, with the R.S. Means data, we can specify the characteristics of each facility type, such as square feet per building and type of exterior wall building material, and thus approximate typical Army projects. Dodge includes all construction activity by category. For example, administrative space can include high rise office complexes in Manhattan, NY, and San Francisco, CA, as well as small one- story buildings in the rural Southwest.

The effect of applying Tri-Service location adjustment factors to R.S. Means national averages is substantial. Applying Tri-Service location factors indicates that average MILCON family housing construction costs are modestly below private-sector costs. When the 9 percent adjustment to the Tri-Service costs is excluded, the Tri-Service costs are only slightly higher than private-sector costs.

Some national builders of family housing do not apply location cost adjustments when bidding on projects. These large firms bring most of their labor force required to a site. Although wages remain subject to Davis-Bacon Act provisions, labor costs for these firms are relatively uniform. Labor wage requirements can be expected to be more important for Army projects compared to the private sector, because many Army projects are located outside major metropolitan areas. The disparities between Davis-Bacon and average local wages are typically greater in more rural areas than in major metropolitan areas.

Differences in Upgrades, Quality, and Other Requirements

The cost comparisons between Army and private-sector projects do not take several factors into account. For example, our examination of family housing specifications at two Army sites indicates considerable variation in requirements. At one site (Fort Hood), the Army requirements exceeded what the private sector would typically construct for off-base military households by about $30,000 per unit.

Sixty percent of the added cost was attributed to an additional 400 square feet of space in MILCON housing. This included an additional bedroom, interior and exterior storage, laundry area, and both living and family room. Quality and upgrade requirements account for about 27 percent of added cost. These include electrical finish and aesthetic specifications. For example, rooms are furnished with ceiling fans, additional phone outlets, window blinds, and three coats of paint. The balance of higher costs is attributable to local conditions, such as steel siding and additional foundation rebar as well as special testing. One requirement, HVAC sheet metal ductwork, is considered an additional cost that provides little if any added benefit compared to the less costly flexible ducts for family housing.

At another site (Fort Bragg), the MILCON specifications matched the private-sector ones. The added costs at this site are limited to "red tape." However, our data indicate that aggregating Army family housing projects, per-square-foot costs were in line with the private-sector costs.

In reference to Army barracks, the new construction is not totally comparable to college dormitories. For example, the Army now constructs barracks with private bathrooms. The typical new upper class college dormitory is designed as a suite, with three to four people, each having a very small private bedroom but sharing a bathroom and kitchen. On a per-square-foot basis, the Army standard would therefore be expected to be more costly than typical college dormitories but the Tri-Service database includes construction projects that were below the current standard.

Other Factors

Two factors may contribute to explaining our finding that Army family housing costs are similar to private-sector costs, but that the Army's construction costs for barracks and administrative space are compared to mostly private-sector projects. One factor is that the Army tends to use a design-build approach for family housing projects, but a design-bid-build approach for most other construction projects. Recent research has shown that design-build construction costs are about 6 percent lower than the more traditional design-bid-build construction costs. This suggests that part of the 15 percent differential between barracks and administrative facility projects in the Army compared to other projects is attributable to the delivery system. Another factor already noted may be that most Army family housing projects are built by large national contractors. These contractors benefit from scale economies and a large skilled labor pool. In addition, these organizations have extensive experience in building projects subject to federal regulations. Local builders during periods of economic expansion have sufficient private-sector work to keep their crews occupied. Therefore, they are less likely to bid on Army projects or, when they bid, charge an additional premium for red tape.

Appendix G
Comparative Analysis of Army and Private-Sector Maintenance and Repair Costs

This appendix examines differences between Army and private-sector maintenance and repair (M&R) expenditures for three categories of facilities:

- Family housing
- Administrative buildings
- Barracks.

METHODOLOGY

Approach and Data Sources

We collected M&R cost data for seven installations:

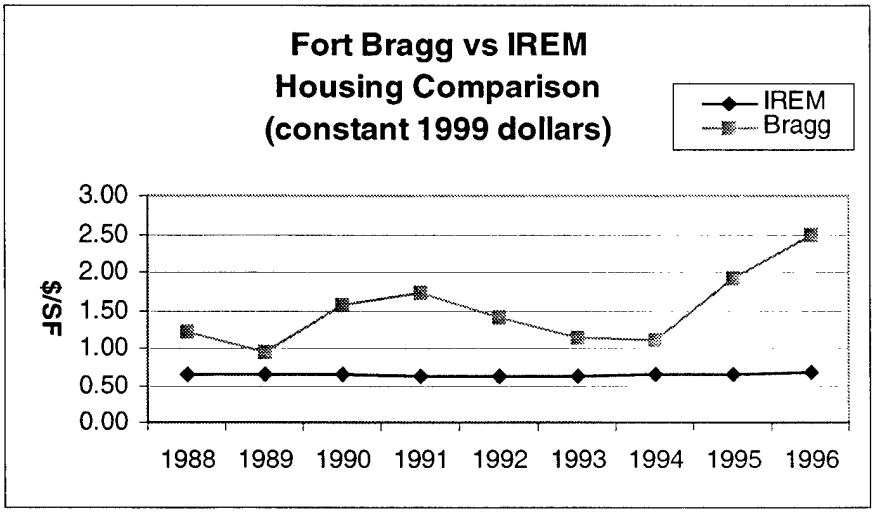
- Fort Bragg
- Fort Meade
- Fort Richardson
- Fort Lewis
- Fort Sam Houston
- Fort Drum
- Fort Hood.

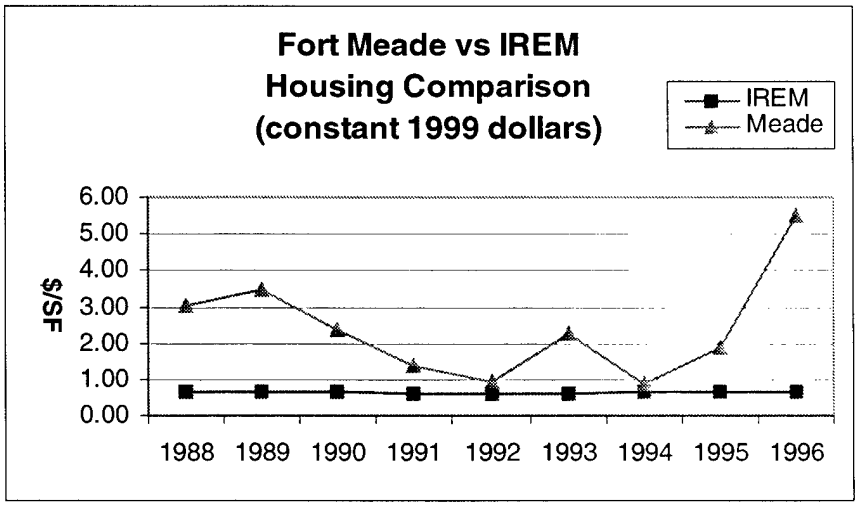
We obtained Army per-square-foot data from the Department of the Army's Directorates of Public Works *Annual Summary of Operations, Volume III–Installations Performance*. We compared the Army data with data from two commercial sources: Institute of Real Estate Management (IREM) for family housing and Building Owners and Managers Association BOMA for administrative buildings and barracks. Because the BOMA data do not treat administrative buildings and barracks separately, we used the combined data for comparing against Army M&R costs for administrative buildings and for barracks.

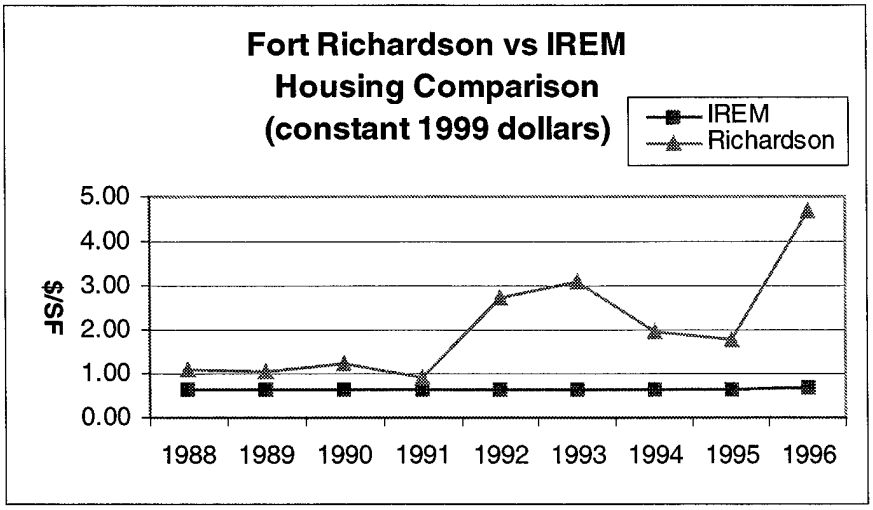
RESULTS BY FACILITY CATEGORY

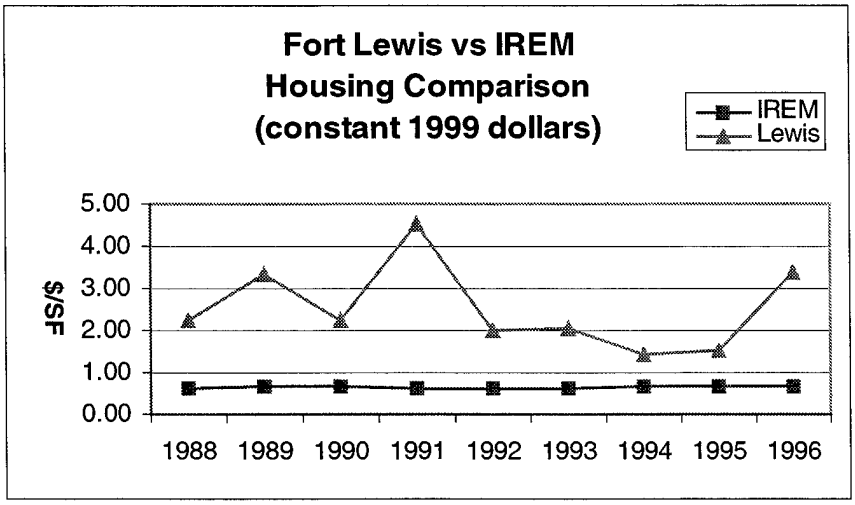
Family Housing

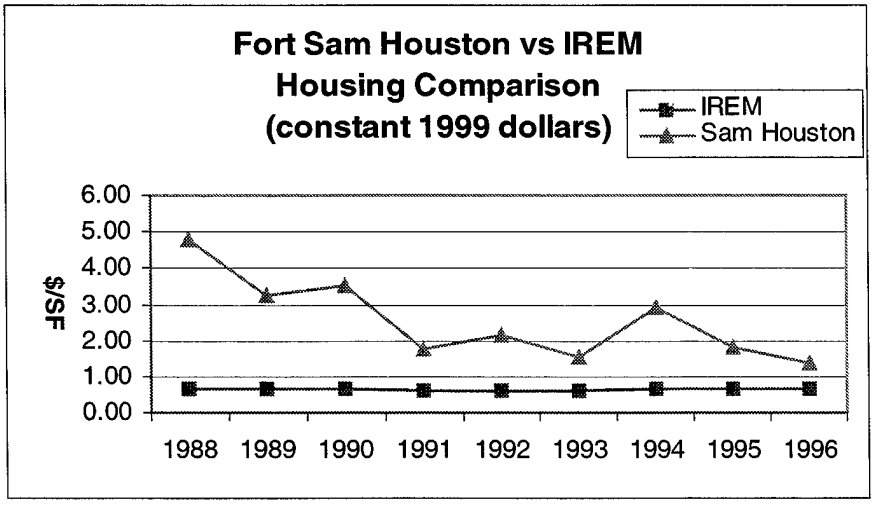
The following seven charts compare private-sector data on family housing M&R costs with data from each of the seven installations.

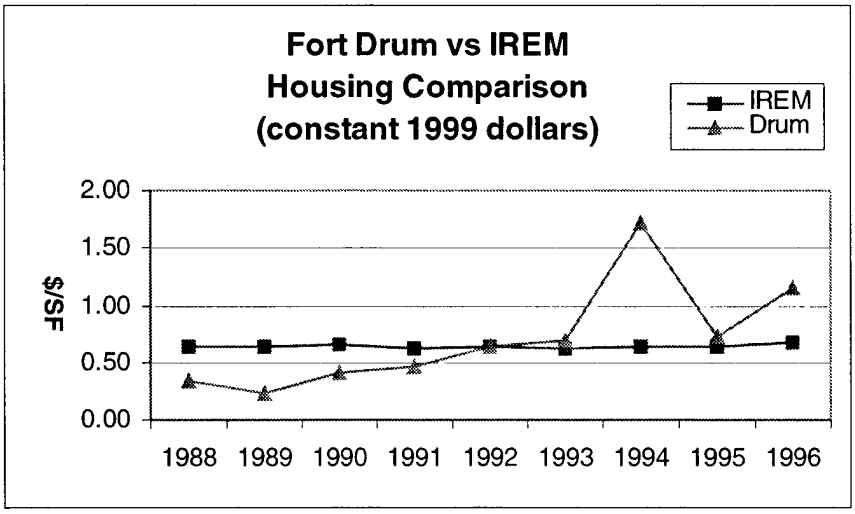


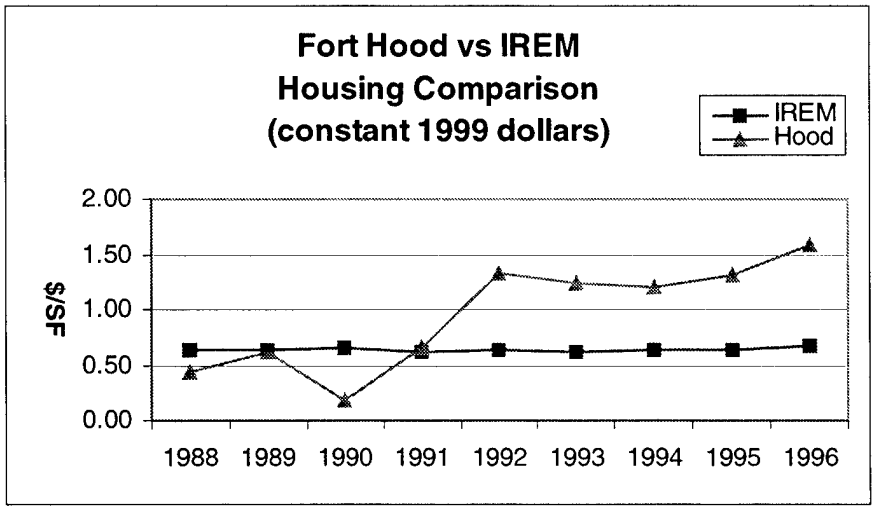



Fort Richardson vs IREM
Housing Comparison
(constant 1999 dollars)
IREM
Richardson
$/SF
5.00
4.00
3.00
2.00
1.00
0.00
1988 1989 1990 1991 1992 1993 1994 1995 1996


Fort Lewis vs IREM
Housing Comparison
(constant 1999 dollars)
IREM
Lewis
$/SF
5.00
4.00
3.00
2.00
1.00
0.00
1988 1989 1990 1991 1992 1993 1994 1995 1996

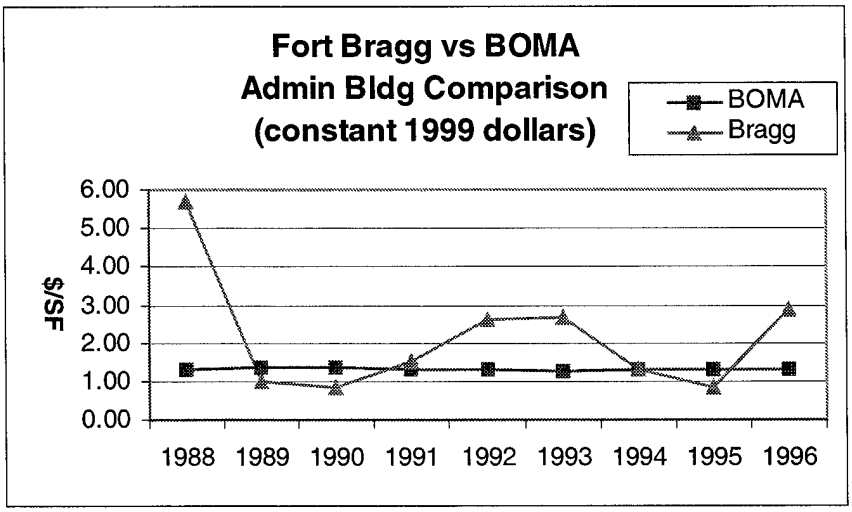

Fort Sam Houston vs IREM
Housing Comparison
(constant 1999 dollars)
IREM
Sam Houston
$/SF
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1988 1989 1990 1991 1992 1993 1994 1995 1996

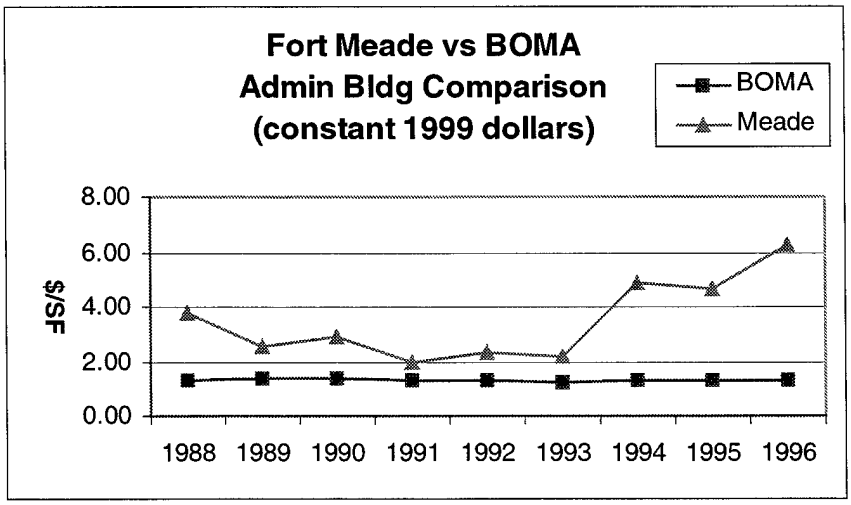


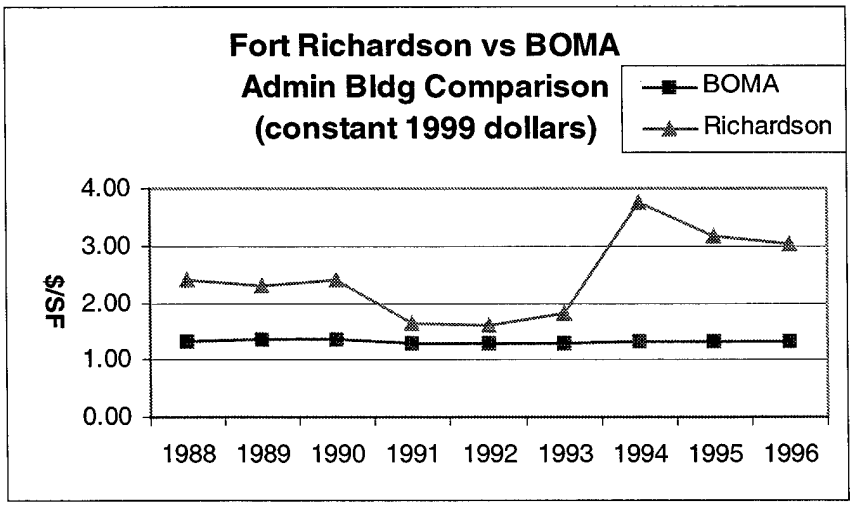


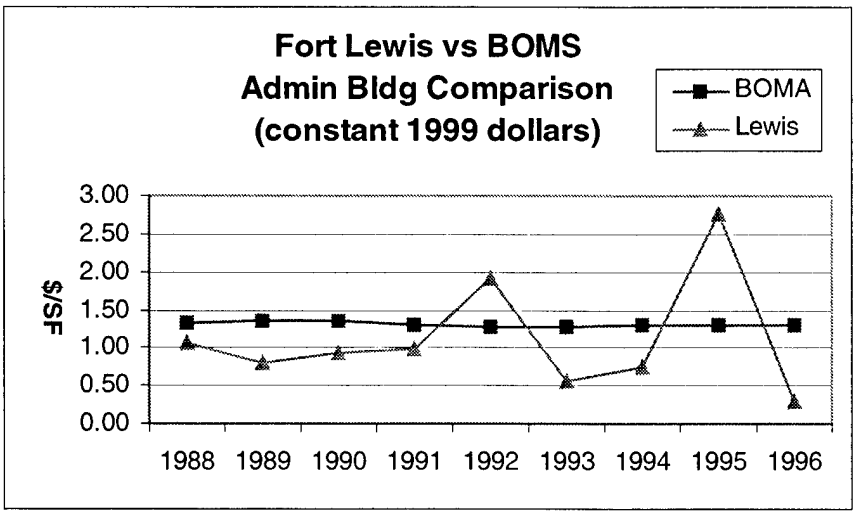
Administrative Buildings

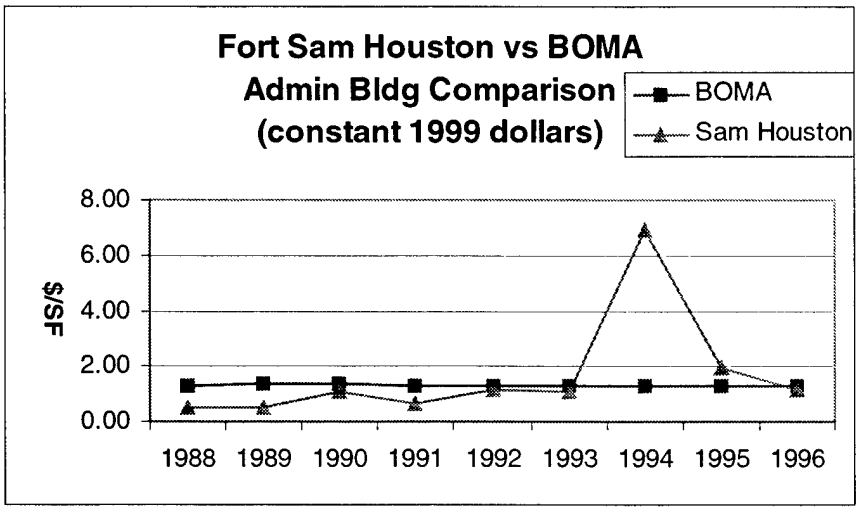
The following seven charts compare private-sector data on M&R costs for administrative buildings and barracks with M&R costs for administrative buildings at each of the seven installations.

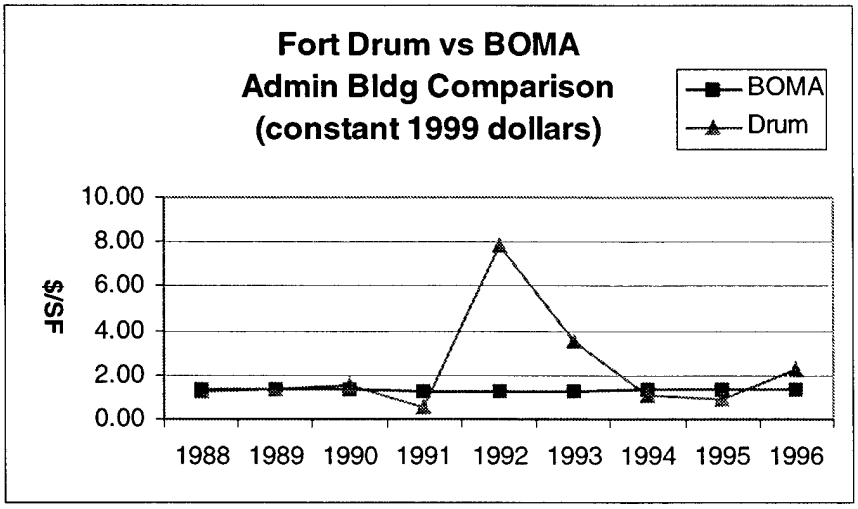

Fort Bragg vs BOMA
Admin Bldg Comparison
(constant 1999 dollars)
BOMA
Bragg
$/SF
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1988 1989 1990 1991 1992 1993 1994 1995 1996

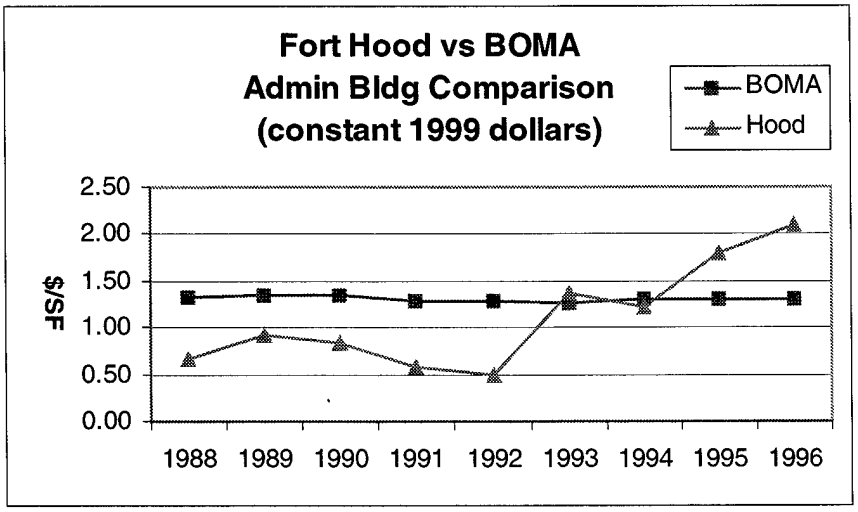

Fort Meade vs BOMA
Admin Bldg Comparison
(constant 1999 dollars)
BOMA
Meade
$/SF
8.00
6.00
4.00
2.00
0.00
1988 1989 1990 1991 1992 1993 1994 1995 1996


Fort Richardson vs BOMA
Admin Bldg Comparison
(constant 1999 dollars)
BOMA
Richardson
$/SF
4.00
3.00
2.00
1.00
0.00
1988 1989 1990 1991 1992 1993 1994 1995 1996


Fort Lewis vs BOMS
Admin Bldg Comparison
(constant 1999 dollars)
BOMA
Lewis
$/SF
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1988 1989 1990 1991 1992 1993 1994 1995 1996

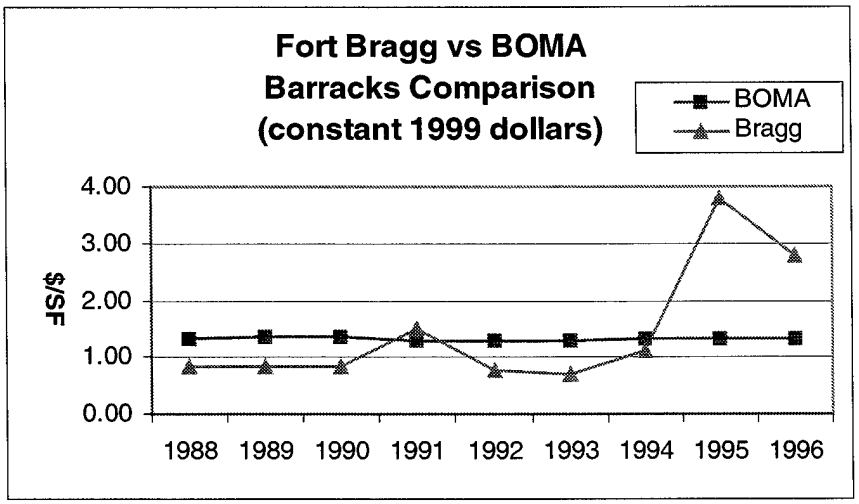

Fort Sam Houston vs BOMA
Admin Bldg Comparison
(constant 1999 dollars)
BOMA
Sam Houston
$/SF
8.00
6.00
4.00
2.00
0.00
1988 1989 1990 1991 1992 1993 1994 1995 1996

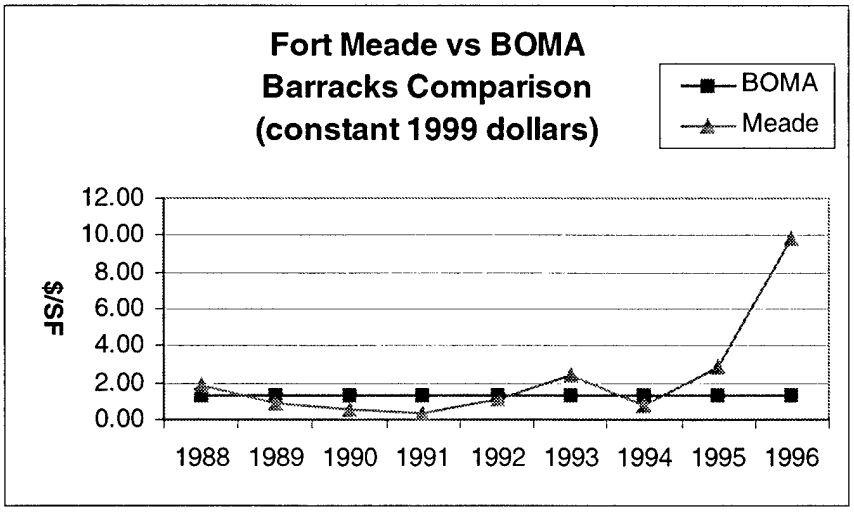

Fort Drum vs BOMA
Admin Bldg Comparison
(constant 1999 dollars)
BOMA
Drum
$/SF
10.00
8.00
6.00
4.00
2.00
0.00
1988 1989 1990 1991 1992 1993 1994 1995 1996

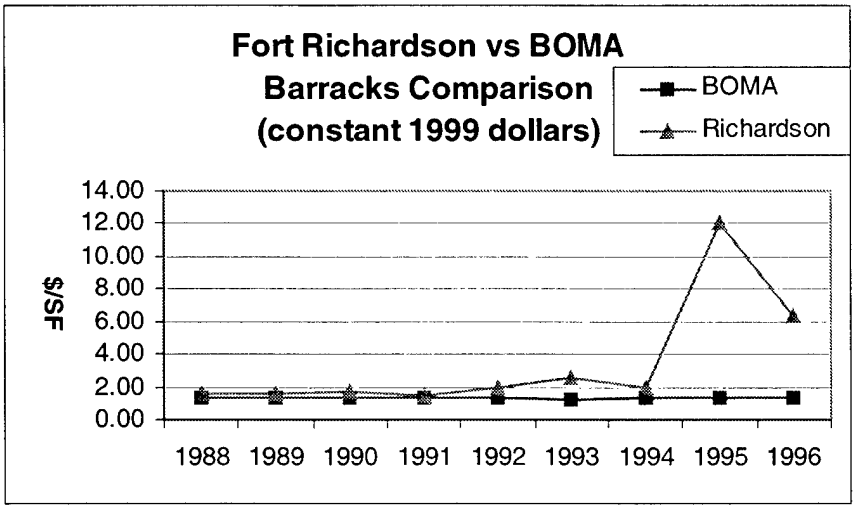


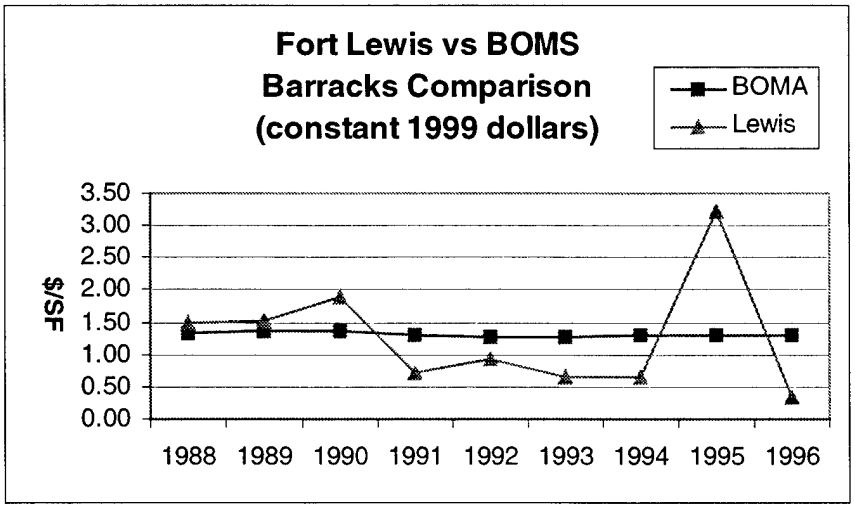
Barracks

The following seven charts compare private-sector data on M&R costs for administrative buildings and barracks with M&R costs for barracks at each of the seven installations.




Fort Meade vs BOMA
Barracks Comparison
(constant 1999 dollars)
BOMA
Meade
$/SF
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1988 1989 1990 1991 1992 1993 1994 1995 1996


Fort Richardson vs BOMA
Barracks Comparison
(constant 1999 dollars)
BOMA
Richardson
$/SF
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1988 1989 1990 1991 1992 1993 1994 1995 1996


Fort Lewis vs BOMS
Barracks Comparison
(constant 1999 dollars)
BOMA
Lewis
$/SF
3.50
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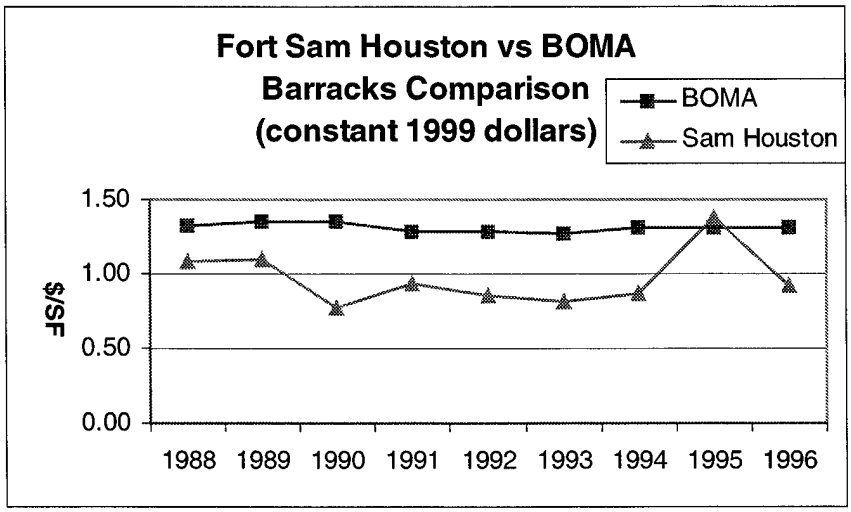
1988 1989 1990 1991 1992 1993 1994 1995 1996


Fort Sam Houston vs BOMA
Barracks Comparison
(constant 1999 dollars)
BOMA
Sam Houston
$/SF
1.50
1.00
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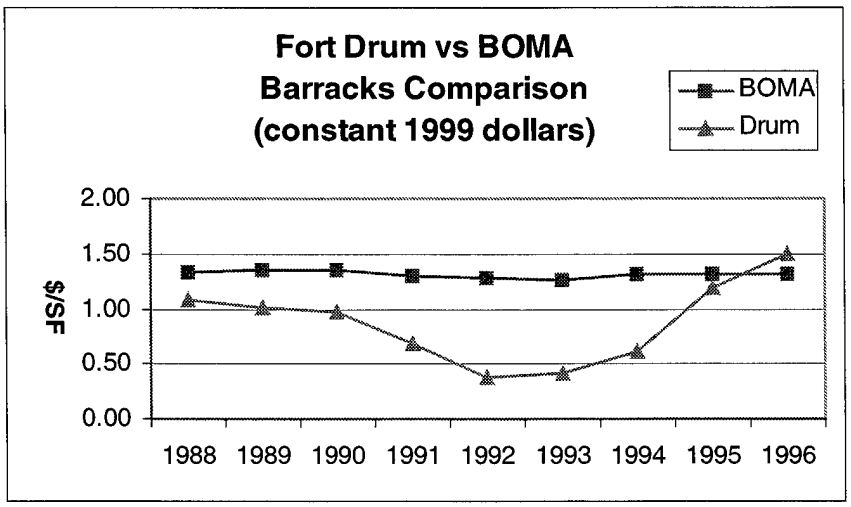
1988 1989 1990 1991 1992 1993 1994 1995 1996


Fort Drum vs BOMA
Barracks Comparison
(constant 1999 dollars)
BOMA
Drum
$/SF
2.00
1.50
1.00
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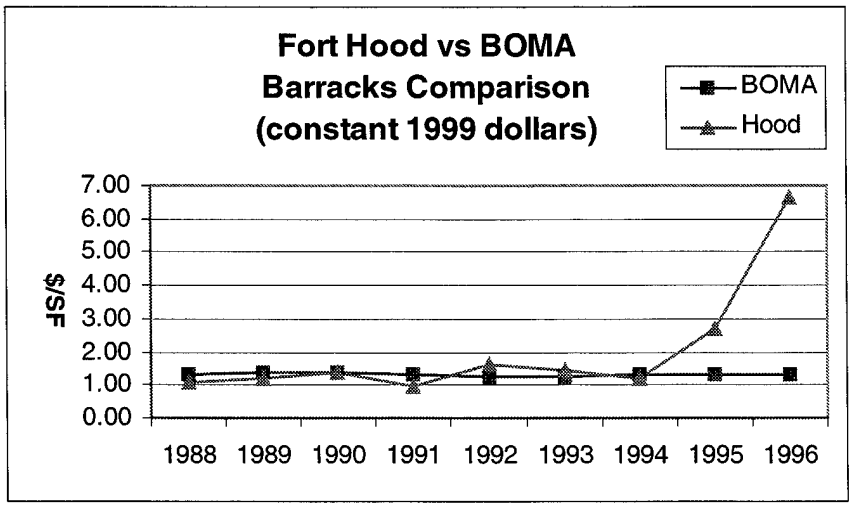
1988 1989 1990 1991 1992 1993 1994 1995 1996


Fort Hood vs BOMA
Barracks Comparison
(constant 1999 dollars)
BOMA
Hood
$/SF
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1988 1989 1990 1991 1992 1993 1994 1995 1996

FACTORS EXPLAINING COST DIFFERENCE

Family Housing

Two main factors cause the Army's M&R costs for family housing to be higher than the private sector's costs: level of service and staffing requirements.

LEVEL OF SERVICE

The Army's level of service for M&R in family housing is higher than the private sector's level of service. For example, the private sector does not respond to service calls to replace light bulbs within a unit; the private sector expects the occupants to do basic routine maintenance. In contrast, the Army's contractor will not only replace an interior light bulb, but will also purchase the light bulb.

STAFFING REQUIREMENTS

The Army requires that all maintenance personnel be licensed in their respected field. For example, the Army's M&R contractor must use a licensed electrician to replaces a light bulb. In contrast, the private-sector firms use a handyman to handles almost all service calls. If this person cannot resolve the issue, then an apprentice or a fully licensed person is sent out.

Administrative Buildings and Barracks

The Army's M&R expenditures for administrative buildings and barracks are higher than the private-sector's costs because of staffing requirements and lack of preventive maintenance (PM). (The quality of service for these facilities is not as high as it is in the private sector.)

STAFFING REQUIREMENTS

M&R personnel on the DPW's staff are mostly all licensed in their respective fields. This is driven by both the DPW's requirements for its personnel and by the lack of new entry-level personnel.

Because of budget constraints and the need to comply with Office of Personnel Management regulations, almost none of the sites we visited have been hiring new maintenance personnel. We believe this is true throughout the Army and DoD. As a result, instead of having a work force that consists of younger personnel learning the trade, the government's work force is made up of older, well-seasoned tradesmen.

The private sector performs maintenance with an organization of general handyman personnel, apprentices, and licensed individuals. The pay structure for the same number of people is much lower for the private sector than the Army.

LACK OF PREVENTIVE MAINTENANCE

Private-sector firms concentrate their efforts and funding on performing preventive maintenance. At almost all of the Army installations we visited, PM was the first work item to be cut when the M&R funding was reduced. The impact of not performing PM regularly reaches many areas of the comparison between the Army and private sector.

Unscheduled Maintenance

When PM is not performed regularly, equipment and systems break down more often. When these systems break down, personnel are required to either repair or replace the equipment as soon as possible. This type of work is mostly unscheduled and often leads to overtime work.

Repair and/or Replace Maintenance

Repair and/or replace maintenance is most often done because a system or piece of equipment failed during normal operation, which means the output of that system or equipment was required at the time of failure. The loss of the system's output affects the customer or occupant of the facility. Because the failure was unscheduled, the occupants must endure the intrusion or interruption of their mission while the system is being repaired or replaced.

The cost of repair, and especially the cost of replacement, is always much higher than the PM cost. It is much cheaper to grease a bearing than to realign or replace that bearing when it fails.

More Frequent Replacement

All equipment and systems have a projected life span. This projected life span is based on regular PM, per the manufacturer's recommendation. Without PM, the system's operating life is shortened. The shorter life span requires the Army to replace that system more frequently than the private sector would.

Appendix H
Cost and Benefit Calculations

We premised the cost-benefit calculations on achieving the following objectives:

- Reduction of the construction cost differential between the Army and private sector by 20 percent by FY08.
- Reduction of the annual maintenance and repair cost differential between the Army and the private sector by 50 percent by FY08.
- Reduction of the equivalent annual rehabilitation cost differential between the Army and the private sector by 10 percent by FY08.

We then calculated the potential savings expected in FY08 using the following conservative assumptions:

- Annual construction budget authority will remain at about $1 billion. The Army spends about 24 percent more than the private sector does for the construction of buildings (other than family housing). Thus, for the same projects, the private sector would spend only $806 million ($1 billion/1.24), and the differential between the Army and the private sector is $194 million ($1 billion - $806 million). Twenty percent of $194 million is $39 million.
- Annual cost savings for facilities other than housing are $317 million for maintenance and repair and $183.4 million for rehabilitation.
  - The Army maintains about 700,000,000 sq. ft. of space at $1.66 per sq. ft. Current annual costs are $1.262 billion (700,000,000 sq. ft. x $1.66 per sq. ft.).
  - Private sector annual maintenance and repair costs for facilities other than housing are $1.33 per sq. ft. The cost differential between the Army and the private sector is $0.33 per sq. ft. ($1.66/sq. ft. - $1.33/sq. ft.).
  - Demand for space will decline by 10 percent shortly after commands and activities begin paying a user fee for their space. Thus, the amount of non-housing space that the Army will maintain will drop from 700,000,000 sq. ft. to 630,000,000 sq. ft.
  - A 50 percent cut in the Army-private sector cost differential is 16 cents ($0.33/2); a more cost efficient Army cost factor would be $1.50 per

sq. ft. ($1.66 - $0.16). Thus, total annual Army costs would be $945 million ($1.50 per sq. ft. x 630,000,000 sq. ft.). The annual cost savings would be $317 million ($1,262 million - $945 million).

- Avoided rehabilitation costs are $183.4 million per year:
  - Cost differential between the Army and the private sector for a 25,000 sq. ft. facility is $708,000 in net present value (NPV) ($2.678 million - $1,970 million) or $28.32 per sq. ft. This value equates to $1.36 per sq. ft.[1] Before user fees are introduced, the Army maintains 700,000,000 sq. ft.; therefore, equivalent total annual rehabilitation costs are $952 million (700,000,000 sq. ft. x $1.36 per sq. ft.).
  - One-tenth of the equivalent annual rehabilitation differential cost is 14 cents ($1.36/10). Therefore, the reduced equivalent annual rehabilitation cost factor is $1.22 per sq. ft. ($1.36 - $0.14).
  - After user fees are introduced, demand for non-housing space will be reduced to 630,000,000 sq. ft. (see above). Therefore, the reduced equivalent annual rehabilitation costs are $768.6 million (630,000,000 sq. ft. x $1.22 per sq. ft.). The difference is $183.4 million ($952 million - $768.6 million).
- Annual cost savings for family housing are $93 million:
  - The Army maintains about 225,000 sq. ft. of space at $1.47 per sq. ft. Current annual costs are $330 million (225,000,000 sq. ft. x $1.47 per sq. ft.).
  - Private-sector annual maintenance and repair costs for facilities other than housing are $0.64 sq. ft. The cost differential between the Army and the private sector is $0.83 per sq. ft. ($1.47/sq. ft. - $0.64/sq. ft).
  - Demand for space will remain stable.
  - A 50 percent cut in the differential between Army and private-sector costs is 41 cents ($0.83/2); a more cost efficient Army cost factor would be $1.06 per sq. ft. ($1.47 - $0.41). Thus, total annual Army costs would be $238 million (225,000,000 sq. ft. x $1.06 per sq. ft.). The annual cost savings would be $92 million ($330 million - $238 million).
  - No cost saving will occur in rehabilitation costs.

[1] We used the following equation to calculate the equivalent annual cost: $A = [Pi(1+i)^n]/[(1+i)^n - 1]$, where A = annual cost, P = present cost ($27), i = discount rate (4.2%), and n = years (50 years).

Cost savings will total $629 million:

- Twenty percent reduction in construction costs = $39 million
- Fifty percent reduction in non-housing maintenance and repair costs = $317 million
- Ten percent reduction in non-housing annual rehabilitation costs = $183 million
- Fifty percent reduction in family housing annual maintenance and repair costs = $93 million.

Since the Army intends to privatize its housing stock, we then eliminated the potential $93 million cost savings from our calculation and rounded down to the nearest hundred million, for a costs savings of $500 million.

Appendix I
Abbreviations

A-E	architect-engineer
ACEC	American Consulting Engineer Council
ACSIM	Assistant Chief of Staff for Installation Management
AGI	Airports Group International
AMPRS	Automated Management and Progress Reporting System
ASIP	Army Stationing and Installation Plan
AWCF	Army Working Capital Fund
BCO	buildability, constructability, and operability
BCOE	biddability, constructibility, operability, and environmental
BOMA	Building Owners and Managers Association
CAPCES	construction appropriation programming, control, and execution system
CEGS	USACE *Guide for Specifications*
CII	Construction Institute of America
CM	construction management
CM@R	construction management at risk
CMAA	Construction Management Association of America
CMMS	computer maintenance management system
CRCC	construction requirements review committee
DAU	Defense Acquisition University
DBIA	Design-Build Institute of America
DCAA	Defense Contract Audit Agency
DFAR	Defense Federal Acquisition Regulations
DOE	Department of Energy
DPW	directorate of public works
FAR	Federal Acquisition Regulations
GSA	General Services Administration
HQDA	Headquarters, Department of the Army

HVAC	heating, ventilation, and air-conditioning
IFB	information for bidders
IFMA	International Facility Management Association
IFS-M	Integrated Facilities Systems-Mini/Micro
IREM	Institute of Real Estate Managers
ISR	installation status reports
M&R	maintenance and repair
MACOM	major command
MDEPs	management decision packages
MILCON	military construction
NAVFAC	Naval Facilities Engineering Command
NIH	National Institutes of Health
O&M	operations and maintenance
OMA	Operation and Maintenance, Army
OMB	Office of Management and Budget
P&D	planning and design
PSMJ	*Professional Services Management Journal*
PM	preventive maintenance
POM	program objective memorandum
PPBES	planning, programming, budgeting, and execution system
PRB	project review board
QA	quality assurance
QC	quality control
RE	resident engineer
RFP	request for proposal
ROE	report of excess
RPLANS	Real Property Planning and Analysis System
RPM	real property maintenance
RPPB	real property planning board
SFCAM	Shore Facility Capital Asset Management
SOW	statement of work
USACE	U.S. Army Corps of Engineers
VA	Department of Veterans Affairs

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The Army and private sector follow similar steps in facility construction and maintenance, but they differ in carrying them out, especially in budget allocation and management. These differences—caused by the Army's operating environment—result in higher costs in its design and construction, and higher costs *and* lower efficiency in maintenance. It does not encounter the competitive market forces that shape efficient organizational behavior and mandate sound financial and organizational management. Consequently, it builds more facilities than it can afford to maintain. To address these problems and reduce costs, this report recommends amending the requirements development process, considering the full program cost of military construction during budget development, emphasizing building designs with shorter "intended-use" design lives, creating web portals permit installations to connect directly with Corps of Engineers "expert assistance centers," establishing standard features for housing designs, using the design-build approach, establishing a user fee for units and activities, establishing a working capital fund to finance operations and maintenance activities, and instituting effective installation property management. These actions require a modest investment to establish the working capital fund and upgrade the computerized maintenance management system. The benefits are significant—cost savings of over $500 million annually within 7 years.

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